TEMS™ CellPlanner

LTE User's Guide

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Preface

Document Conventions

This document uses the following conventions:

Bold type	Window names, button names, and keyboard keys are displayed as bold text. Example: Click **Edit.**
Menu↗Selection	Navigation in menu paths are displayed as bold text with arrows between menu levels.
`Typewriter type`	File names and literal input and output. Example: `sites.xml`
Italic type	Book titles and definitions are displayed in italic. Examples: *carrier mapping, Technical Reference Manual*
Left-click Right-click	All instructions including mouse clicks assume a mouse configured with the left mouse button as primary button.

Navigation

Use the ALT ← and ALT → buttons to navigate between link jumps in the Manuals.

Assumed Knowledge

This documentation presumes that you have good knowledge about radio network planning principles and the radio technology to plan.

Disclaimer

The parameter values in this manual are just examples to help you getting started quickly, and do not constitute any performance guarantees for the planned equipment of your final network planning.

Proper parameter values depend on the equipment version, the operator's business plan, and the operator's network deployment strategy. Recommended parameter values should be provided by the operator, the equipment vendor or your service delivery organization.

Manuals

The following PDF manuals are delivered with the TEMS CellPlanner software:

Installation Guide
EN/LZT 108 9831 R4A

Describes system requirements, how to install and configure TEMS CellPlanner components and manage licenses, and provides an overview of all TEMS CellPlanner components. The procedures must be performed by a user with administrator privileges on the local computer. Some procedures require that you are an authorized TEMS CellPlanner administrator.

Common Features User's Guide
EN/LZT 108 9832 R4A

Includes Glossary of terms used in TEMS CellPlanner, concepts about licenses, and how use projects, explorer objects used by more than one radio technology, how to add sites and use site tools, filters, plots, neighbors, AMI, tuning propagation models, ASMT (Automatic Sector Model Tuning), puncturing, export and import data, and work with projects on server. Here TEMS CellPlanner administrators find how to administer users, groups and projects on servers shared by multiple users.

Common Features Technical Reference Manual
EN/LZT 108 9833 R4A

Describes radio technology independent algorithms, parameters and file formats.

GeoData User's Guide
EN/LZT 108 9834 R4A

Describes geodata concepts, supported geodata formats, conversion between different map formats, how to use map data tools in TEMS CellPlanner. The chapters about providing and importing map data are intended for administrators of map data. Other chapters are intended for users of map data.

Map Import Wizard User's Guide
EN/LZT 108 9943 R2A

Describes how to import map data using a generic wizard similar to the one provided with TEMS LinkPlanner. The intended reader is administrator of map data.

LTE User's Guide
EN/LZT 108 9944 R3A

Describes how to use LTE functions of TEMS CellPlanner, including analysis, and creation of plots and reports.

LTE Technical Reference Manual
EN/LZT 138 0235 R2A

Describes LTE network planning principles, analysis details for advanced users, and cell ID planning principles.

WCDMA User's Guide
EN/LZT 108 9837 R4A

How to use WCDMA functions of TEMS CellPlanner, including analysis, and creation of plots and reports.

WCDMA Technical Reference Manual
EN/LZT 108 9838 R4A

Describes concepts and overviews of WCDMA algorithms, and HSPA and MBMS in TEMS CellPlanner.

GSM User's Guide
EN/LZT 108 9835 R4A

Describes how to use the GSM functions of TEMS CellPlanner, including analysis, and creation of plots and reports.

GSM Technical Reference Manual
EN/LZT 108 9836 R4A

Describes overlaid/underlaid cell structures, reuse patterns, manual frequency planning, automatic frequency planning (AFP), automatic hopping frequency set (HFS) planning, optimization of BSIC, HSN and MAIO, fractional load planning, and effective subscriber modeling. Also describes the GSM algorithms and file formats used in TEMS CellPlanner.

WiMAX User's Guide
EN/LZT 108 9839 R4A

Describes how to use the WiMAX functions of TEMS CellPlanner, including analysis, and creation of plots and reports.

1
Overview of TEMS CellPlanner

This chapter provides an overview of the TEMS CellPlanner product.

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About TEMS CellPlanner

TEMS™ CellPlanner is a graphical PC-based application for designing, implementing, and optimizing mobile radio networks. It assists you in performing complex tasks, including network dimensioning, traffic planning, site configuration, frequency planning, and network optimization.

Installation

The Installation Guide describes how to install software and licenses.

Product Packaging

The product package includes the software components listed below.

What is actually installed depends on your selection in the installation wizard.

Product Components	Selecting this component installs...
• TEMS CellPlanner *named "TEMS CellPlanner Client" in the manuals*	• Radio Technology Features • Planning Features • Manuals • Map tools, geodata conversion software, demo maps, filters, scripts • Citrix software - relevant only if you are going to offer this TEMS CellPlanner installation as a Citrix service
• Enterprise Server	Enterprise Server software plus the User Administration software
• Zero Admin Server	Zero Admin Server software plus the User Administration software
• User Administration	User Administration software only
• License Server	License Server software only

Some of the components are licensed, see Licensed Components on page 1-3.

The Installation Guide provides an overview of each component and how the components relate to each other.

Licenses

The Installation Guide describes how to install licenses.
The Common Features User's Guide describes how to activate licensed features.

Licensed Components

Three of the Product Components are licensed:

TEMS CellPlanner *named "TEMS CellPlanner Client" in the manuals*	To start TEMS CellPlanner you need a license for at least one of the Radio Technology Features. Additional licenses are required for each of the Radio Technology Features and Planning Features to use.
Enterprise Server	License required to start the server
Zero Admin Server	License required to start the server

Radio Technology Features

Each of the radio technology software modules listed below require an installed and activated license. How to use the radio technology software is described in adherent user guides and technical reference manuals.

- GSM
- WCDMA
- WCDMA,HSPA
- WiMAX
- LTE

Planning Features

Additional planning features can be used together with the radio technology software. These additional software modules require a license for the feature itself and a license for the adherent radio technology:

• Automatic Cell Planning	Requires WCDMA or WCDMA,HSPA license
• Automatic Frequency Planning	Requires GSM license. This license is required also for automatic HFS planning.
• Automatic Measurement Integration and ASMT	Requires license for at least one of the Radio Technology Features ASMT = Automatic Sector Model Tuning.

Support and FAQ

For support and FAQ about TEMS CellPlanner, use the TEMS support web site:

www.ascom.com/networktesting

To provide TEMS support with information when reporting a problem, follow the instructions in chapter *Support Information* in the Installation Guide.

2
LTE in TEMS CellPlanner

This chapter provides an overview of the LTE capabilities and analysis functions of TEMS CellPlanner.

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About LTE in TEMS CellPlanner

The LTE module in TEMS CellPlanner allows you to build an LTE network plan based on geographical data, analyze the network plan with a variety of propagation models, present analysis results in plots and reports, and export/import LTE data.

LTE License

You need an LTE license to use the LTE module in TEMS CellPlanner.

- For information on how to install the license, see *Installing Client Software* in the *TEMS CellPlanner Installation Guide*.
- For information on how to activate the license, see *Licenses* in *TEMS CellPlanner Common Features User's Guide*.

LTE Standards

TEMS CellPlanner provides analysis of network and terminal equipment compliant with applicable parts of 3GPP series 36.

LTE Capabilities

The LTE module in TEMS CellPlanner supports the following capabilities:

- Full FDD, half FDD and synchronized TDD (S-TDD) frequency bands
- Cells supporting 2x2 MIMO combined with 2x2 tx diversity, or 2x tx diversity only, or SIMO (1x2 MRC)
- Terminals supporting channel models according to Extended ITU Models
- Support for intra-frequency LTE-LTE neighbor relations and inter-frequency IRAT (inter-technology) relations of type LTE/WCDMA and LTE/GSM), including blacklisting unwanted neighbors

LTE Plots and Reports

TEMS CellPlanner produces the following results for LTE:

- Pathloss and best server coverage plots
- UL and DL interference, traffic performance, and utilization plots and reports
- MIMO data rate gain and transmission scheme plots
- Cell ID plan

Advanced LTE Analysis and Planning

TEMS CellPlanner allows advanced LTE analysis and planning by using:

- Live traffic spreading
- Automatic cell ID planning

Importable and Exportable LTE Data

TEMS CellPlanner supports import and export of the following LTE data:

- Cell data
- Neighbor lists (intra-technology, IRAT)
- Fixed subscribers
- Live traffic (import only)

3
Getting Started with TEMS CellPlanner

The first time you use TEMS CellPlanner, read chapter *Using TEMS CellPlanner* in the *TEMS CellPlanner Common Features User's Guide*

There you find information on the following topics:

- how to start and exit TEMS CellPlanner
- how to use the windows, menus and explorers

4
LTE Project

This chapter describes how to initiate and save a project. After having setup your project using the procedures in this chapter, proceed with the subsequent chapters to build your LTE network plan.

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About LTE Projects

An LTE network plan is developed within a *project*, stored as a file for single-user access, or in a database on a server to be shared with other planners.

Note: *Your changes to a project are stored persistently first when you explicitly* ***save*** *the project. When you* ***apply*** *changes they are valid for the ongoing session but the changes are* <u>*not*</u> *saved persistently.*

Working with an LTE Project

The order of procedures in this chapter follows a standard order for defining a project in TEMS CellPlanner.

Create or Open a Project

Start your work with the network plan by creating a new TEMS CellPlanner project, or open an existing TEMS CellPlanner project to modify an initiated project.

Prerequisites

TEMS CellPlanner Client is started.

Procedures

To create a new project, see *Define General Project Settings* in the *TEMS CellPlanner Common Features User's Guide*.

To open an existing project, see *Open Existing Project* in the *TEMS CellPlanner Common Features User's Guide.*

Note: *If the project is or shall be stored in database on a server, see instead chapter Working with Projects on Server in the TEMS CellPlanner Common Features User's Guide.*

Define Project Specific Information

Some information is project specific, such as project name, default import project, map layers used for analysis, object names, and global GSM and WiMAX parameters.

The project specific information is configured from **File↗Project settings**. If you share the project with other planners, these settings apply for all users of the project.

Prerequisites

A project is opened.

Procedures

Procedures in *italic* font are described in the *TEMS CellPlanner Common Features User's Guide* (default) or the *TEMS CellPlanner GeoData User's Guide*.

Use the following procedures to define project specific information:

1. *Define General Project Settings*
2. *Select Coordinate System for Project*
3. *Add Map Layers to Project*

   Note: *You must add map layers in two places:*
   a. In ***Project settings*** *you define the map layers to consider in pathloss calculations. These map layers are input to the propagation models.*
   b. In ***Map properties*** *you define the map layers to display on screen. See TEMS CellPlanner Common Features User's Guide for more information.*

4. *Define Object Names*

Define User Specific Information

Some settings are user specific, such as calculation results directory, AMI database location, auto backup parameters, TEMS Automatic settings, and working area definitions.

The user specific information is configured from **File↗User settings**. If you share the project with other planners, the user settings apply only to a single user and override default project settings.

Prerequisites

A project is opened.

Procedure

Use the procedure *Define User Settings* in the *TEMS CellPlanner Common Features User's Guide* to define user specific information.

Check, Save and Close a Project

Your changes to a project must be saved as a project file or in database on a server to be kept persistently. Before saving it is recommended to check the consistency of the project.

Prerequisites

A project is opened.

Procedures

Procedures in *italic* font are described in the *TEMS CellPlanner Common Features User's Guide*.

Use the following procedures to check, save and close a project:

1. *Check Project Consistency*
2. *Save Project*

   Note: *If the project is or shall be stored in database on a server, see instead chapter Working with Projects on Server.*

3. *Close Project*

5
Working with TEMS CellPlanner Server

You can share your LTE network plan with other planners by storing it on a TEMS CellPlanner server.

Read more about sharing network plans in chapter Working *with Projects on Server* and *Administering Database Users and Projects* in the *TEMS CellPlanner Common Features User's Guide*.

6
LTE System Data

This chapter describes how to define the system data of an LTE network plan.

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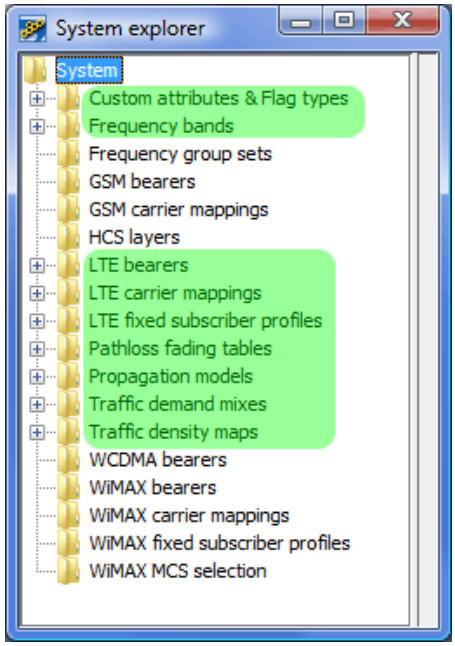
About LTE System Data

Before adding sites and cells you must define the non-equipment dependent *system data* in the **System explorer**.

The system data relevant for LTE network plans is highlighted in the figure below:



How to configure the actual equipment's use of the system data is described in LTE Sites, RBSs, Sectors, Cells and Networks on page 9-1.

Define LTE System Data - Step by Step

The typical order of defining system data for LTE is reflected in the list below and in the order of procedures in this chapter.

LTE Network System Data

The network system data below is required for Pathloss calculations:

❶	LTE Carrier Mappings	RBs, carrier utilization
❷	LTE Frequency Bands	band limits, carrier limits
❸	LTE Bearers	bit rate, priority, frequency band
❹	Propagation Models	land use dependent radio wave behavior defined per frequency band - to later be included in antenna branches of LTE RBSs and radio repeaters

For LTE Best Server Analysis of coverage you also need the following network data:

❺	Pathloss Fading Tables	fading margins per land use category - at least a table with zero margins must be defined

You may define your own attributes for sites, cells, and other objects:

❻	Custom Attributes and Flag Types	(optional) user defined attributes for network objects, visible in the map display

LTE Subscriber System Data

Subscriber related system data is needed for LTE Best Server Analysis of coverage, and for traffic and interference calculations in LTE Analysis (Including Interference):

❶	Traffic density maps	(optional) traffic density per land use category, refining the Traffic Demand Mixes
❷	Traffic Demand Mixes	mix of bearers with supporting terminal types (traffic demands) for mobile LTE UEs
❸	LTE Fixed Subscriber Profiles	(optional) combinations of terminal types and supported bearers of fixed LTE devices - one profile per fixed subscriber

LTE Carrier Mappings

You configure all carrier related parameters of an LTE frequency band in an *LTE carrier mapping*. Several frequency bands can use the same carrier mapping.

FDD or S-TDD Duplex Type

Before you set the time fraction parameters of the carrier mapping you must know the duplex type of the frequency band, that is, if the carrier mapping shall be used for full or half frequency-division duplexing (FDD) or synchronized time-division duplexing (S-TDD).

- In *full-duplex FDD*, LTE RBSs as well as LTE terminals can transmit and listen simultaneously. Each of the DL and UL time fraction parameters must thus be less than or equal to 100%.
- In *half-duplex FDD*, LTE RBSs can transmit and listen simultaneously, while LTE terminals switch between transmitting and listening. The performance is the same as for full-duplex FDD, thus you model half-duplex FDD in the same way as full-duplex FDD.
- In *S-TDD*, LTE RBSs as well as terminals switch between transmitting and listening. The sum of the DL and UL time fraction parameters must be less than or equal to 100%.

In FDD mode, different carriers are used for downlink and uplink respectively with a frequency distance defined by the duplex distance. In S-TDD mode, the same carrier is used for downlink and uplink.

The duplex type is configured for each of the LTE Frequency Bands.

Define LTE Carrier Mapping

You can define several LTE carrier mappings depending on how you want to dispose your carriers. At a later stage in the planning, you select one carrier mapping per frequency band, see LTE Frequency Bands on page 6-7.

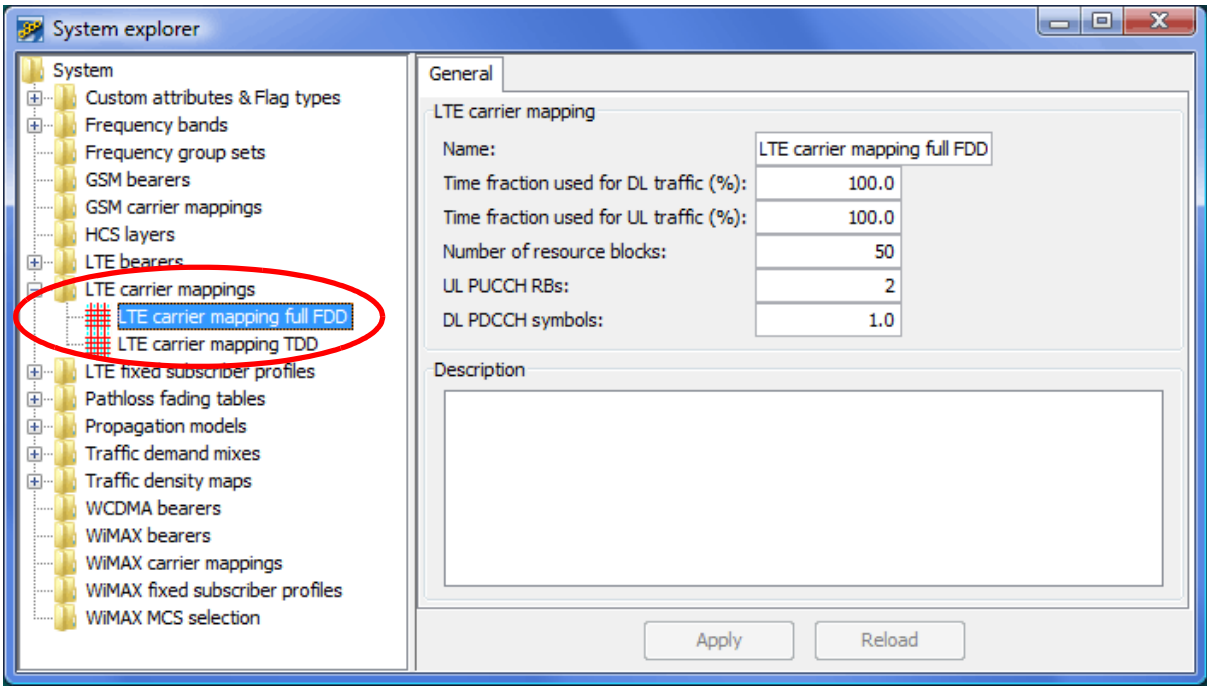
Prerequisites

A project is opened.

Procedure

1. Select **Utilities↗System explorer**.
2. Right-click the **LTE carrier mappings** folder and select **Add LTE carrier mapping**. The **LTE carrier mapping** window is displayed.
3. Set the time fraction parameters depending on the duplex type, as explained in Fields on Window "LTE Carrier Mapping" on page 6-5.

4. Modify the other parameters as required.
5. Click **Apply** to preserve the settings. The following example shows two defined carrier mappings:



Fields on Window "LTE Carrier Mapping"

Field	Description
Name	Name of the carrier mapping. Maximum 128 alphabetical or numerical characters. Do not use /,\,' or %.
Time fraction used for DL traffic (%) Time fraction used for UL traffic (%)	The percentage time used for downlink and uplink traffic respectively on this carrier. Range: 0 - 100%. Initial value = 100%. In FDD mode, each of these parameters must be less than or equal to 100%. In S-TDD mode, the sum of these parameters must be less than or equal to 100%. See FDD or S-TDD Duplex Type on page 6-4.

Field	Description
Number of resource blocks	Maximum number of resource blocks used for a certain carrier bandwidth. The actual allocation of resource blocks to the carrier is random, performed when scheduling traffic for the carrier. See Range: 2- 1000. Initial value = 25. The number of resource blocks entered here is mapped to the carrier bandwidth of the frequency band. For information on how number of resource blocks affect the carrier bandwidth, read about parameter **Carrier bandwidth** in Fields on Window "Frequency Band - Advanced" on page 6-9. ***Note:*** *A frequency band selecting this carrier mapping gets the instant number of maximum resource blocks, and thus a corresponding carrier bandwidth, but only when creating the frequency band. Modifying the number of resource blocks does not automatically update the carrier bandwidth of a frequency band already including this carrier mapping.*
UL PUCCH RBs	Number of resource blocks used for the uplink control channel. Range: 0-10. Initial = 2.
DL PDCCH symbols	Symbols used for the downlink control channel, out of 14 in each sub-frame. Range: 1-3. Initial = 1.
Description	Optional description of the carrier mapping

LTE Frequency Bands

For any radio technology you need to configure a frequency band and select EARFCN channel numbers to be used in your network plan. Refer to the *TEMS CellPlanner Common Features Technical Reference Manual* for a description on how frequency limits, channels and carriers relate to each other.

The 3GPP standard 36.101 specifies 14 FDD bands and 8 S-TDD bands, optionally with additional bandwidth for some of the FDD bands.

An LTE frequency band is in TEMS CellPlanner configured as follows:

- FDD or S-TDD Duplex Type
- Consists of one base sub-band and optionally one additional sub-band
- Associated with one of the LTE Carrier Mappings, defining the number of RBs allocated for the carrier, and the time fraction for DL and UL traffic

You later associate the following objects with LTE frequency bands:

- Propagation Models - associated with one LTE frequency band
- LTE Bearers - associated with one or more LTE frequency bands

Default LTE Frequency Band

TEMS CellPlanner provides default settings for the LTE frequency band corresponding to band number 1 in 3GPP TS 36.101:

Band	Downlink Frequency Band (MHz)	Downlink Channel Number EARFCN	Duplex Distance (MHz)
1	2110 + 0.1 *n	0 ≤ n ≤ 599	190

Separate EARFCNs are used for uplink and downlink. The uplink EARFCN is calculated by subtracting the duplex distance from the downlink EARFCN. In the case of S-TDD, the same EARFCN is used for uplink and downlink, hence the duplex distance is 0.

This default LTE frequency band has a carrier bandwidth of 5 MHz and a channel separation of 0.1 MHz, with complete settings as in the table below. For parameter descriptions, see Define LTE Frequency Band on page 6-8.

Parameter	Initial value
Base frequency	2110.0 MHz
Base channel	0
Duplex type	FDD
Duplex distance	190.0 MHz
DL upper edge (MHz)	2169.9 MHz
DL lower edge (MHz)	2110.0 MHz
UL upper edge (MHz)	1979.9 MHz

Parameter	Initial value
UL lower edge (MHz)	1920.0 MHz
Carrier bandwidth	5.0 MHz
Base sub-band	
Lower edge channel	0
Upper edge channel	599
Number of carriers	12
Carrier distance	50
Lower edge frequency	2110.0 MHz
Upper edge frequency	2169.9 MHz
Channel separation	0.1 MHz

Define LTE Frequency Band

Use this procedure to add and configure an LTE frequency band.

Prerequisites

An LTE carrier mapping is defined, see Define LTE Carrier Mapping on page 6-4.

Procedure

See procedure *Define Frequency Band* in the *TEMS CellPlanner Common Features User's Guide* for a generic description.

The LTE specific settings are as follows:

1. Select **Utilities↗System explorer**.
2. Right-click the **Frequency band** folder and select **Add.**
3. Select **LTE** in the **Select System type** window.
4. The initial settings in the **Frequency band - Advanced** are retrieved from the Default LTE Frequency Band.
5. Assign a **Carrier mapping** with suitable carrier mapping settings for the duplex type, see FDD or S-TDD Duplex Type on page 6-4. If no carrier mapping exists you are prompted to create one with default settings, see Fields on Window "LTE Carrier Mapping" on page 6-5.
6. Only if this is the first time you **Apply** the frequency band for a certain carrier mapping, the **Carrier bandwidth** is updated according to the number of resource blocks in the carrier mapping.
7. Optionally Define LTE Sub-band for extra bandwidth.
8. Proceed with Select LTE Carrier Channels on page 6-10.

Fields on Window "Frequency Band - Advanced"

Field	Description
System type Base frequency (MHz) Base channel Duplex type Duplex distance (MHz)	See *Define Frequency Band* in the *TEMS CellPlanner Common Features User's Guide*
Carrier mapping	Selected from a list of defined carrier mappings. The carrier mapping parameters must suit the **Duplex type**. See FDD or S-TDD Duplex Type. Only one carrier mapping can be selected for the frequency band, but the same carrier mapping can be used in several frequency bands. The **Carrier bandwidth** initially depends on the selected carrier mapping.
Carrier bandwidth (MHz)	The bandwidth of one carrier. Corresponds to parameter channel bandwidth in 3GPP TS 36.101. Range: 1.25 - 100. Default = 5.0 MHz. The first time you apply a carrier mapping for the frequency band, the carrier bandwidth is updated to the selected carrier mapping's **Number of resource blocks** according to the table below. ***Note:*** *Modifying the number of resource blocks does not update a carrier bandwidth already applied in a frequency band using that carrier mapping. Modifying the carrier bandwidth does not update the number of resource blocks. See LTE Carrier Mappings on page 6-4.* **Number of resource blocks** / **Carrier bandwidth** <= 6 / 1.25MHz 7 - 15 / 3 MHz 16 - 25 / 5 MHz 26 - 50 / 10 MHz 51 - 75 / 15 MHz 76 - 100 / 20 MHz 101 - 500 / >=100 MHz
(Frequency sub-band parameters)	See *Define Frequency Band* in the *TEMS CellPlanner Common Features User's Guide*

Define LTE Sub-band

LTE frequency bands may contain an additional sub-band with different properties than the base sub-band.

Prerequisites

An LTE frequency band is defined, see Define LTE Frequency Band on page 6-8.

Procedure

See procedure *Define Sub-band* in the *TEMS CellPlanner Common Features User's Guide* for a generic description.

The LTE specific settings are as follows:

1. You must manually ensure that **carrier distance** >= (**carrier bandwidth / channel separation**) to avoid overlapping carriers.
2. After **Apply**, proceed with Select LTE Carrier Channels on page 6-10.

Select LTE Carrier Channels

When you have defined your frequency band(s) you shall select the frequency band channels (EARFCNs) to use as carriers in LTE cells.

For details, see procedure *Select Carrier Channels* in the *TEMS CellPlanner Common Features User's Guide*.

LTE Bearers

An *LTE bearer* is characterized by its bit rate and priority. The current version of TEMS CellPlanner allows selection of QoS class GBR by setting GBR bit rate values higher than zero.

The LTE bearers are as part of LTE Terminal Types indirectly also part of the Traffic Demand Mixes in analysis functions. The same bearer definition may be used in more than one frequency band.

Define LTE Bearer

Before you configure terminal types, traffic cases and traffic demands you need to define the supported bearers.

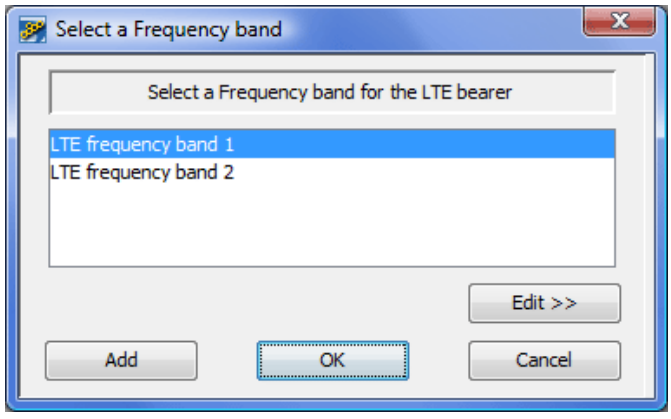
Prerequisites

The frequency band(s) to include in the bearer are defined, see Define LTE Frequency Band on page 6-8.

Procedure

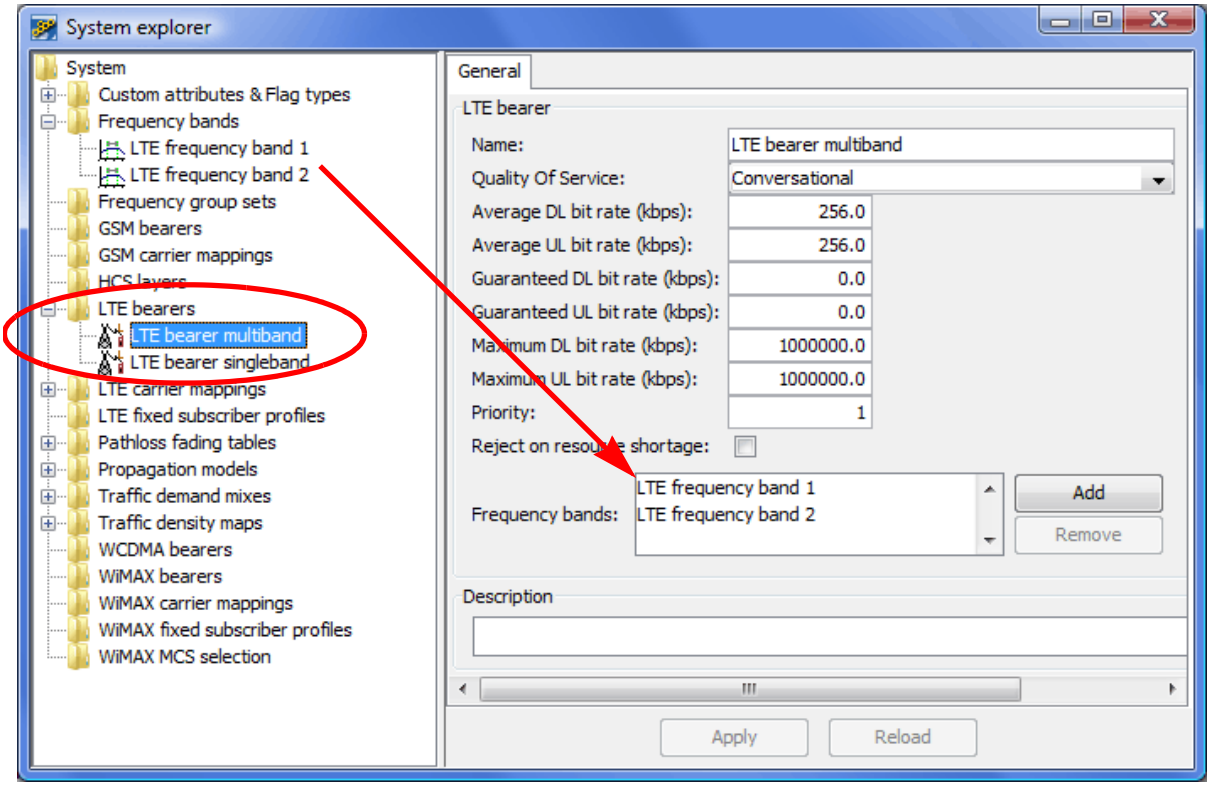
Follow these steps to define an LTE bearer:

1. Select **Utilities↗System explorer**.
2. Right-click the **LTE bearers** folder and select **Add LTE bearer** from the menu. The **Select a frequency band** dialog appears:



3. Select a frequency band and click **OK**. The **LTE bearer - General** tab appears with the frequency band included.
4. An LTE bearer may include multiple frequency bands. To add frequency bands to the bearer, click **Add**, select the additional frequency band and click **OK.**
5. Give the bearer an appropriate **Name** and optionally a **Description**.

6. The result might look as in the following example where the bearer is supported in two frequency bands:



7. Modify the other parameters as required, see Fields on Window "LTE Bearer" on page 6-13.

8. Click **Apply** to preserve the settings of the LTE bearer.

You can now include the LTE bearer as supported by LTE Terminal Types on page 7-4.

Fields on Window "LTE Bearer"

Field	Description
Name	Name of the LTE bearer. Maximum 128 alphabetical or numerical characters. Do not use /,\,' or %.
Average DL bitrate (kbps)	Average maximum DL data rate. The served data rate in plots and reports are limited by this parameter. Range: 0 - 100 000. Default = 256 kbps.
Average UL bitrate (kbps)	Average maximum UL data rate. The served data rate in plots and reports are limited by this parameter. Range: 0 - 100 000. Default = 256 kbps.
Guaranteed DL bit rate (kbps)	Bearers of QoS class "GBR" shall have a value higher than zero. Range: 0 - 100 000. Default = 0 kbps.
Guaranteed UL bit rate (kbps)	Bearers of QoS class "GBR" shall have a value higher than zero. Range: 0 - 100 000. Default = 0 kbps.
Maximum DL bit rate (kbps)	Range: 0 - 1 000 000. Default = 1 000 000 kbps.
Maximum UL bit rate (kbps)	Range: 0 - 1 000 000. Default = 1 000 000 kbps.
Priority	High priority bearers are scheduled first. Range: 1 - 7, where 1 is the highest priority. Default = 1.
Reject on resource shortage	Relevant for non-GBR bearers only. If selected, traffic on the UE using this bearer is blocked if the DL or UL capacity is not enough to provide the requested bit rate. Initially unselected. The corresponding blocking reasons are *Rejected on DL* or *Rejected on UL*, see
Frequency bands	One or more frequency bands for the bearer. Selected from a list of frequency bands.
Add	Adds a frequency band to the bearer
Remove	Removes a frequency band from the bearer
Description	Optional description of the bearer

LTE Fixed Subscriber Profiles

An *LTE fixed subscriber profile* is associated with one bearer and one terminal type, and is characterized by its requested data rate in DL as well as UL.

When you later define LTE Fixed Subscriber Sites, each such site shall be associated with one fixed subscriber profile.

Define LTE Fixed Subscriber Profile

Prerequisites

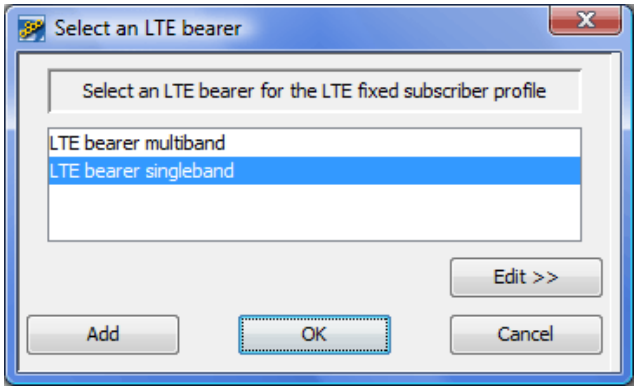
You must first define a bearer and a terminal type for the fixed subscriber profile. See instructions in the following procedures:

- Define LTE Bearer on page 6-11.
- Define LTE Terminal Type on page 7-5

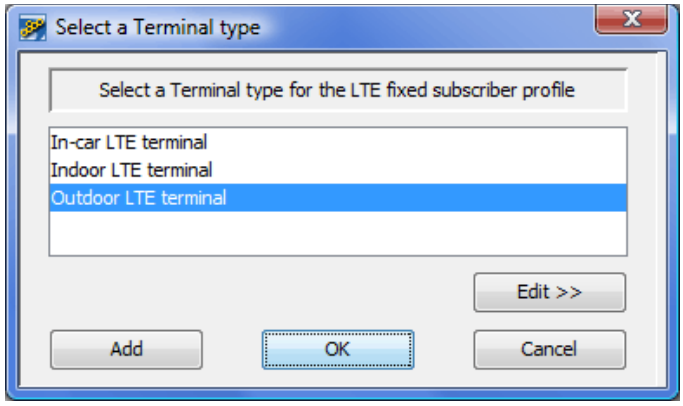
Procedure

Do as follows to define an LTE fixed subscriber profile:

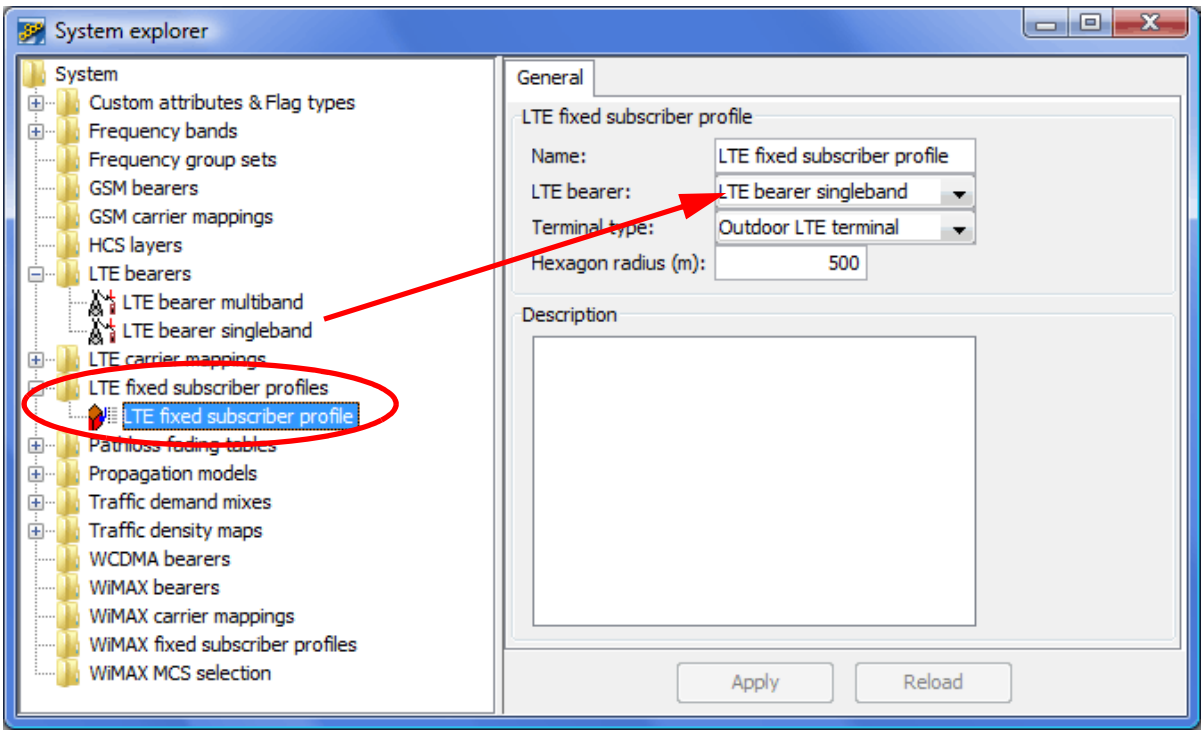
1. Select **Utilities↗System explorer**.
2. Right-click the **LTE fixed subscriber profiles** folder and select **Add LTE fixed subscriber profile** from the menu. The **Select an LTE bearer** dialog appears:



3. Select a bearer and click **OK**. The **Select a Terminal type** dialog appears as in the following example:



4. Select a terminal type and click **OK**. The **LTE fixed subscriber profile** window appears as in the following example:



5. Enter an appropriate **Name** and optionally a **Description**.
6. Modify parameters as desired, see Fields on Window "LTE Fixed Subscribe Profiler" on page 6-16.
7. Click **Apply** to preserve the settings.

You can now add the LTE fixed subscriber to a site. You must add multiple fixed subscribers to sites using multiple bearers or multiple terminal types.

Fields on Window "LTE Fixed Subscribe Profiler"

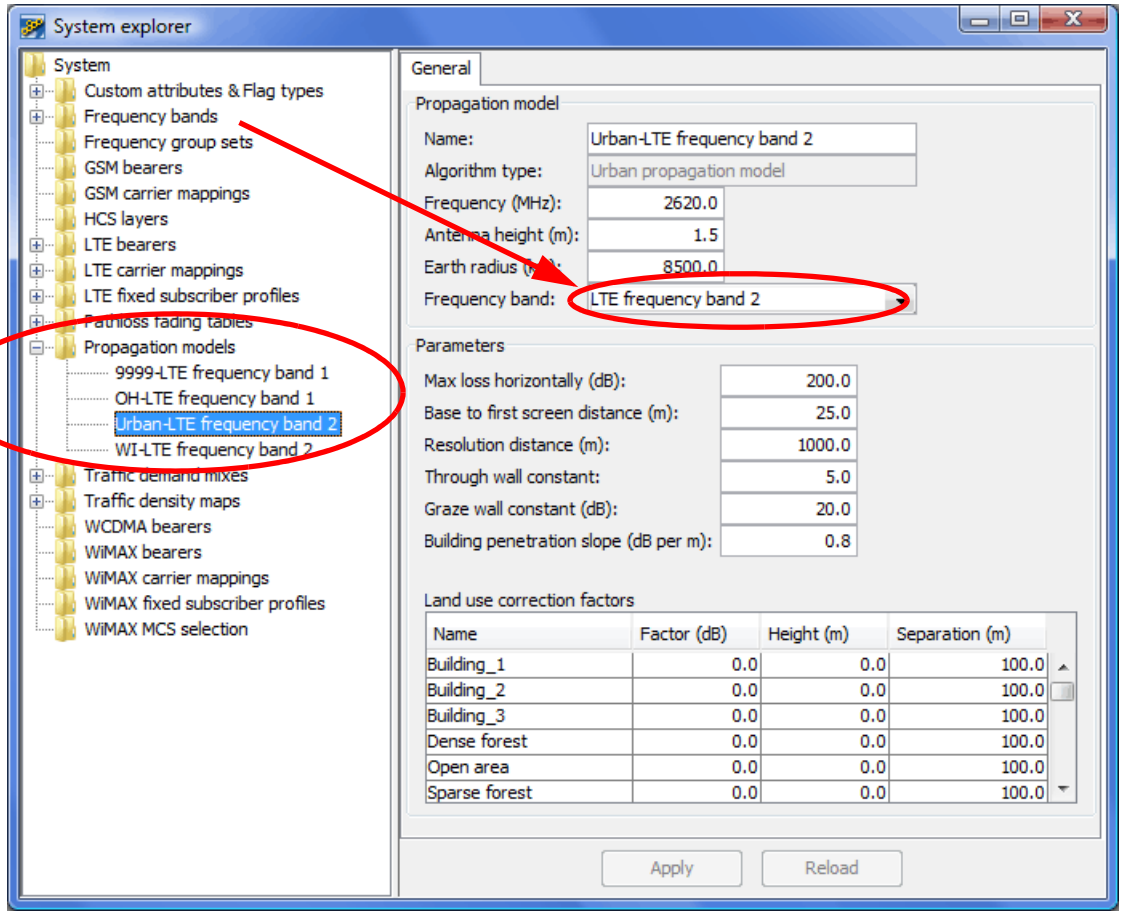
Field	Description
Name	Name of the LTE fixed subscriber profile. Maximum 128 alphabetical or numerical characters. Do not use /,\,' or %.
Terminal type	List of terminal types. ***Note:*** *You can select one terminal type only. If the offered traffic at a site is generated by more than one terminal type, then you must add more fixed subscribers to the site.*
LTE bearer	List of LTE bearers supported by the terminal type. ***Note:*** *You can select one bearer only. If the offered traffic at a site comprises more than one bearer, then you must add more fixed subscribers to the site.*
Hexagon radius (m)	The hexagon radius of a fixed subscriber site as displayed on the map. Range: 0 .. 100000. Default = 500 m.
Description	Optional description of the fixed subscriber profile

Propagation Models

Propagation models are included in each antenna branch (see Define LTE Antenna Branch Template on page 8-13) and used for pathloss calculations.

The propagation models supported by TEMS CellPlanner are described in the *TEMS CellPlanner Common Features Technical Reference Manual*.

The example below shows a set of four propagation models, all with default values. Each propagation model is associated with an LTE frequency band:



How to define the propagation models is described in the *TEMS CellPlanner Common Features User's Guide*, in the following chapters:

- Define Propagation Model Types
- Ericsson 9999 Propagation Model
- Urban Propagation Model
- Okumura-Hata Propagation Model
- Walfisch-Ikegami Model

Traffic Demand Mixes

The subscribers in a network are distributed according to a certain pattern, a *traffic demand mix*, which is the sum of all bearer specific traffic demands.

A *traffic demand* of a bearer defines a percentage mix of terminal types using the bearer, with subscribers distributed uniformly over the analysis area or according to a geographical pattern described in a *traffic density map*. A traffic demand can model unsymmetrical LTE traffic load, as DL and UL bit rates of LTE bearers may be different.

To obtain realistic LTE Analysis results you must first configure this distribution of subscribers and the use of terminals in the network.

For information on how to configure traffic demands, see chapter *Define Traffic Demand* in the *TEMS CellPlanner Common Features User's Guide*.

Pathloss Fading Tables

A *fade margin* is a factor by which a particular signal fades, in addition to pathloss, when a subscriber is connected in a certain terrain. You can specify the DL and UL fade margins in a pathloss fading table, where you map landuse codes to fade margins. User-defined or random pathloss fading tables are used in the LTE Analysis.

With a *tuned* propagation model and detailed map data you can run accurate pathloss predictions, and the need for fading margins then decreases.

See chapters *Define Pathloss Fading Tables* and *Propagation Model Tuning* in the *TEMS CellPlanner Common Features User's Guide*.

Custom Attributes and Flag Types

Some objects in your project can be tagged with your own text or graphical attributes shown on the map display. The following objects holding LTE custom attributes are predefined in the System Explorer when you create a new project:

- LTE RBS attributes
- LTE cell attributes
- LTE fixed subscriber attributes

If you migrate an LTE project from TEMS CellPlanner 8.x you must add the System explorer object for **LTE fixed subscriber attributes** manually by **Add custom attributes** before you can add attributes to it.

Read more about C*ustomizing Attributes for Sites, RBSs and Cells* in the *TEMS CellPlanner Common Features User's Guide*.

7
LTE Equipment Types

This chapter describes how to define the equipment types of an LTE network plan.

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Feeder Cable Types (Optional) 7-3
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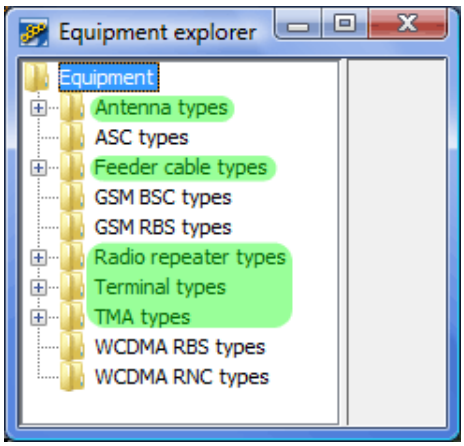
LTE Terminal Types 7-4
Suggested LTE Terminal Types 7-4
Data Rate Mapping 7-4
Define LTE Terminal Type 7-5
Model Multiple Bearers 7-8

About LTE Equipment Types

Before defining sites and cells with physical *equipment*, you need to define the *equipment types*.

The equipment types relevant for LTE are highlighted in the figure below:



This chapter describes how to define the equipment types. How to define the actual equipment based on these types is described in LTE Sites, RBSs, Sectors, Cells and Networks on page 9-1.

Define LTE Equipment Types - Step by Step

The typical order of planning equipment types for LTE is reflected in the list below, and in the order of procedures in this chapter.

Network radio equipment types:

❶ Antenna Types

❷ TMA Types (Optional)

❸ Feeder Cable Types (Optional)

❹ Radio Repeater Types (Optional)

Subscriber equipment types:

❺ LTE Terminal Types - for mobile UEs and fixed subscribers

LTE Network Radio Equipment Types

Antenna Types

You can define LTE antenna types manually or by import from antenna files.

The recommended method is to import predefined antenna types, see *Import EET/Planet 2.x Antennas* in the *TEMS CellPlanner Common Features User's Guide*.

If you prefer defining the antennas manually, follow the instructions in the antenna chapters in the *TEMS CellPlanner Common Features User's Guide*.

TMA Types (Optional)

See *Define TMA Types* in the *TEMS CellPlanner Common Features User's Guide*.

Feeder Cable Types (Optional)

See *Define Feeder Cable Types* in the *TEMS CellPlanner Common Features User's Guide*.

Radio Repeater Types (Optional)

See *Define Radio Repeater Types* in the *TEMS CellPlanner Common Features User's Guide*.

LTE Terminal Types

To get accurate LTE Analysis results you need to define the most common terminal types expected in your radio network, both for mobile or stationary UEs and for fixed subscribers.

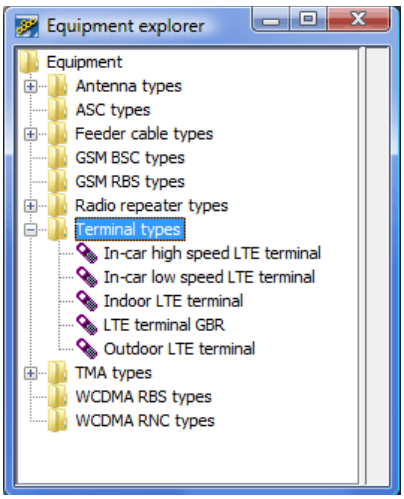
Suggested LTE Terminal Types

The following terminal types, or similar, are suggested for an LTE project:

- indoor
- in-car low-speed
- in-car high-speed
- outdoor

You can also specify GBR or non-GBR terminal types.

Examples of LTE terminal types in the Equipment explorer:



Data Rate Mapping

Important: New channel models are used in TEMS CellPlanner 9.0. If you import a project from TEMS CellPlanner 8.1, the data rate mappings of the terminal types will automatically be replaced by a default mapping (Channel model EPA, doppler frequency 5 Hz, open-loop MIMO). To use a project created in TEMS CellPlanner 8.1 you must manually assign a new mapping wherever the default value is not appropriate.

When you configure an LTE terminal type you select one of the data rate mappings listed below per LTE terminal type. The default mapping is highlighted.

Channel model	Doppler shift	Corresponding UE speed in the 2.6 GHz band	Spectral efficiency technique
EPA5	5 Hz	2.1 km/h	Closed-loop MIMO
EPA5	*5 Hz*	*2.1 km/h*	*Open-loop MIMO*
EVA5	5 Hz	2.1 km/h	Closed-loop MIMO
EVA5	5 Hz	2.1 km/h	Open-loop MIMO
EVA70	70 Hz	30 km/h	Closed-loop MIMO
EVA70	70 Hz	30 km/h	Open-loop MIMO
ETU70	70 Hz	30 km/h	Closed-loop MIMO
ETU70	70 Hz	30 km/h	Open-loop MIMO
ETU300	300 Hz	128 km/h	Closed-loop MIMO
ETU300	300 Hz	128 km/h	Open-loop MIMO

For detailed information on data rate mappings, see the *TEMS CellPlanner LTE Technical Reference Manual*.

Define LTE Terminal Type

All terminal types have some radio technology independent parameters such as antenna height, gain and loss. You also define a number of radio technology specific parameters. LTE terminal types are characterized by their supported bearers, number of resource blocks (RB), backoff characteristics, data rate mappings, and UE category. You must set these parameters to give correct input to the analysis calculations.

Use this procedure to define the most common LTE terminal types in your radio network, and associate each terminal type with supported bearers.

Prerequisites

- Get information about the most common LTE terminal types to consider in the analysis of your network. See Define LTE Terminal Type on page 7-5.
- The bearer(s) supported by the terminal type are defined, see Define LTE Bearer on page 6-11

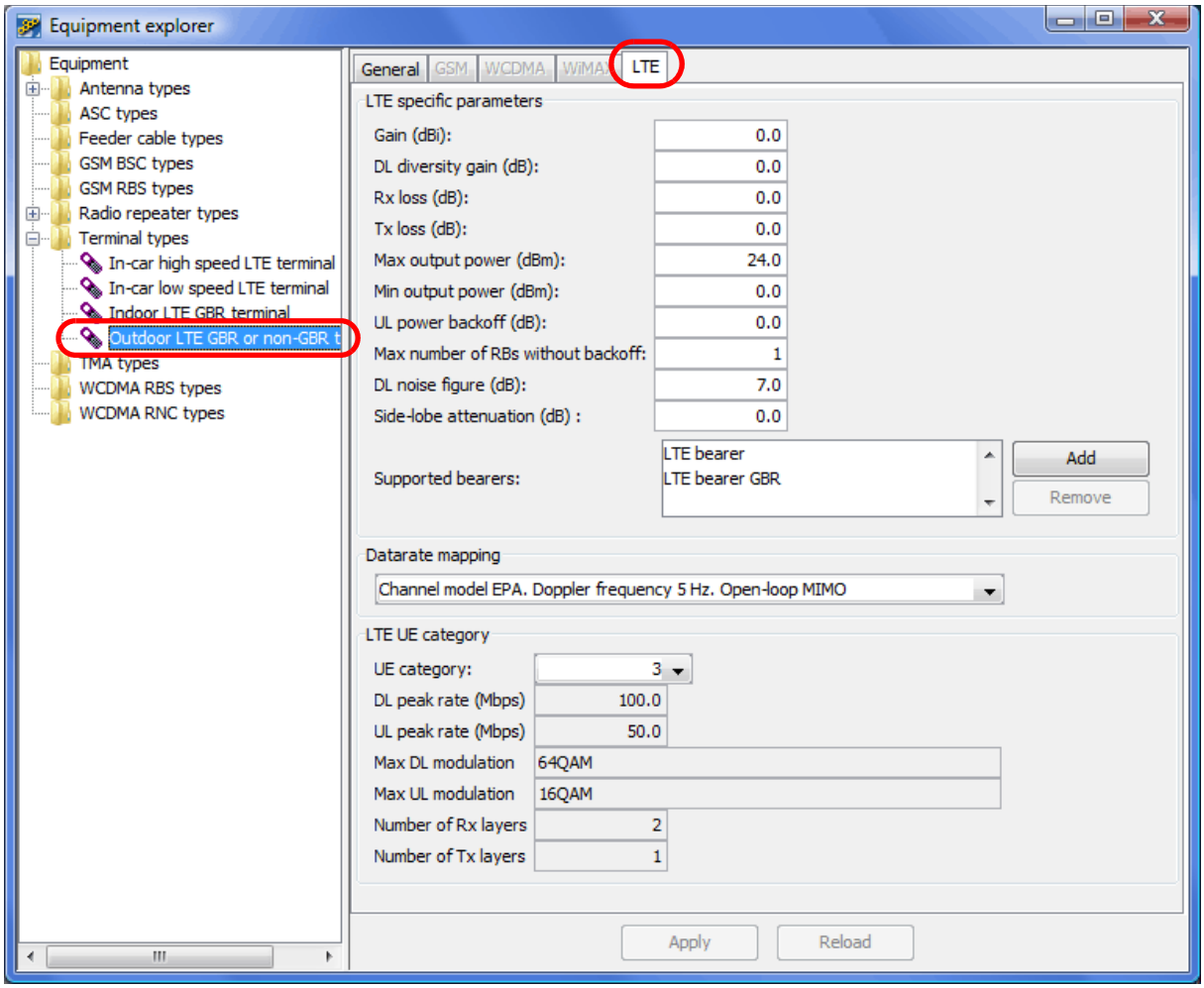
Procedure

1. From the **Utilities** menu, click **Equipment explorer**.
2. From the left-hand browser window, right-click the **Terminal types** folder and select **Add Terminal type**. The **Terminal type - General** tab panel appears.

3. Assign the radio technology independent terminal parameters, see Fields on Window "Terminal - General" on page 7-7.
4. Select the **LTE support** option to enable the LTE tab.
5. Select the **LTE** tab and assign the LTE specific parameters, see Fields on Window "Terminal - LTE" on page 7-7.

   Important: If this project was created in TEMS CellPlanner 8.1, you must reassign the Data Rate Mappings to use 9.0 values.

6. Click **Apply** to preserve the settings. The result might look as in the following example, illustrating an outdoor terminal supporting two bearers:



Fields on Window "Terminal - General"

The general terminal parameters are described in the following table:

Field	Description
Name	Name of the terminal type. The name will appear in the left-hand browser window. Maximum 128 alphabetical or numerical characters. Do not use /,\,' or %.
Antenna height	Height of terminal antenna, above ground level. Range 0 - 100. Default = 1.5.
• GSM support • WCDMA support • WiMAX support • LTE support	The radio technologies supported by the terminal. Selecting an option enables the corresponding tab.
Description	Description of the terminal type (optional).

Fields on Window "Terminal - LTE"

The LTE specific terminal parameters are described in the table below. The settings of each terminal type should be provided by the network operator or by terminal vendors.

Field	Description
Gain (dBi)	Antenna gain. Range: 0 - 100. Default = 0 dB.
DL diversity gain (dB)	Range: 0 - 10. Default = 0 dB.
Rx loss (dB)	The sum of losses such as body loss, building penetration loss, and feeder loss from an external terminal antenna. Range 0 - 50. Default = 0 dB.
Tx loss (dB)	
Max output power (dBm)	The maximum transmit power of the terminal. Range: 0 - 40. Default = 24 dBm.
Min output power (dBm)	The minimum transmit power of the terminal. Range: -90 - 0. Default = -50 dBm.
UL power backoff (dB)	Compensates transmitter imperfections. OFDM specific offset from maximum UE tx power. Reduces unlinear effects when reaching maximum tx power for UEs using high bandwidth, that is, transmitting on many RBs. A UE transmitting on many RBs must use low power. Range: 0 - 10. Default = 1 dB.
Max number of RBs without backoff	The maximum number of RBs on which the UE can transmit with full power. Range: 1 - 100. Default = 8.
DL noise figure (dB)	Range: 0 - 40. Default = 7 dB.
Side-lobe attenuation (dB)	Relevant for fixed subscribers only, ignored at analysis of mobile UEs. Attenuation of downlink and uplink interfering signals, relative to the main lobe. Range: 0 - 50. Default = 0 dB.

Field	Description
Supported bearers	Each bearer supported by this terminal type is associated with one or more frequency bands. Each bearer/frequency band is part of a traffic demand, see Traffic Demand Mixes on page 6-18. See also Model Multiple Bearers on page 7-8. The **Add** button adds a bearer to the list of supported bearers. The **Remove** button removes the selected bearer from the list of supported bearers.
Data rate mapping	Conversion table for mapping C/(I+N) to data rate. See Data Rate Mapping on page 7-4.
LTE UE category parameters	
UE category	Range: 2 - 4. Default: 2. Selects predefined, read-only UE dependent parameters: • DL peak rate (Mbps) • UL peak rate (Mbps) • Max DL modulation • Max UL modulation • Number of Rx layers • Number of Tx layers See LTE UE Category Parameters.

LTE UE Category Parameters

The table below specifies the LTE UE category dependent parameter settings:

	UE Category		
Parameters	2	3	4
DL peak rate (Mbps)	50	100	150
UL peak rate (Mbps)	25	50	50
Max DL modulation	64QAM	64QAM	64QAM
Max UL modulation	16QAM	16QAM	16QAM
Number of Rx layers	2	2	2
Number of Tx layers	1	1	1

Model Multiple Bearers

To model a multi-bearer terminal type in TEMS CellPlanner you define a traffic demand mix with two or more traffic demands, each using one of the multiple bearers combined with the terminal type.

An LTE terminal in a live network can share its limited output power between multiple bearers simultaneously. Note that this power sharing can not be modeled in the current version of TEMS CellPlanner.

8
LTE Templates

This chapter describes how to define the templates of an LTE network plan.

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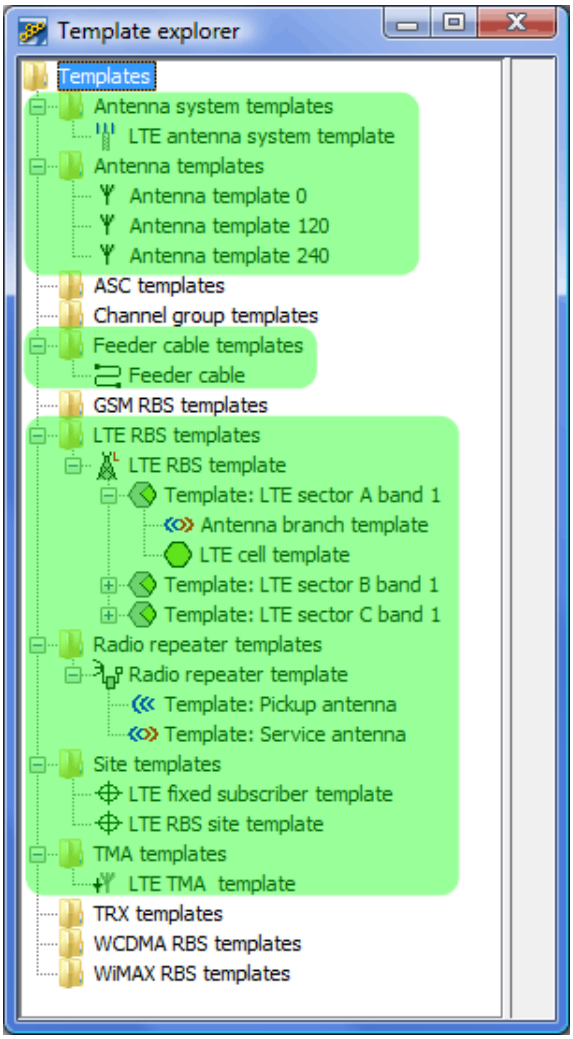
About LTE Templates

You can save time by using templates when building your network plan.

The parameter values in templates are initial values in objects using the templates.

Note: *Changes in templates do not affect already created objects.*

The templates relevant for LTE network plans are highlighted in the figure below.



Define LTE Templates - Step by Step

The typical order of defining LTE templates is reflected in the list below, and in the order of procedures in this chapter.

1. Define Antenna Templates
2. Define TMA Templates (Optional)
3. Define Feeder Cable Templates (Optional)
4. Define Antenna System Templates
5. Define Radio Repeater Templates (Optional)
6. Define LTE RBS Templates
7. Define LTE Sector Templates for LTE RBS template
8. Define LTE Cell Template for LTE sector template
9. Define LTE Antenna Branch Templates for LTE sector template
10. Define LTE RBS Site Template
11. Define LTE Fixed Subscriber Template
12. Define Radio Repeater Site Templates (Optional)

Example: LTE Templates for Network with Three-Sector RBSs

You may create several templates in the same way, using different frequency bands and antennas. In each template, enter appropriate parameter values.

The example below describes templates for a network with three-sector RBSs and mobile UEs only. The example does not include templates for radio repeaters or fixed subscribers. How to define each template is described on subsequent pages:

Templates	Recommended Template Configurations
Define three antenna templates	Name the antenna templates: • "LTE antenna 0" • "LTE antenna 120" • "LTE antenna 240" Set different azimuths in each template, typically 0, 120, 240 degrees.
Define one antenna system template	Name it "LTE antenna system template". Add the three antenna templates.
Define one LTE RBS template	Select the "LTE antenna system template". Name this template "LTE RBS template".

Templates	Recommended Template Configurations
Define three LTE sector templates for the LTE RBS template	Select the appropriate frequency band. Name the sector templates: • "LTE sector A band 1" • "LTE sector B band 1" • "LTE sector C band 1"
Define one LTE cell template for each sector	Select the carrier to use in the sector. Name the cell templates: • "LTE cell A" • "LTE cell B" • "LTE cell C"
Define one antenna branch template for each sector	For each antenna branch template, include the appropriate antenna template, select antenna branch type (Rx, Rx/Tx, or Tx), and select a propagation model. If this is a cable repeater, select the cable repeater option.
Define an LTE RBS site template	Name it "LTE RBS site template" and include the LTE RBS template.

Antenna Equipment Templates

Most templates define standard configurations of antenna equipment. The antenna related templates relevant for LTE are outlined in this section.

Antenna Templates

See *Define Antenna Templates* in the *TEMS CellPlanner Common Features User's Guide*.

TMA Templates (Optional)

See *Define TMA Templates* in the *TEMS CellPlanner Common Features User's Guide*.

Feeder Cable Templates (Optional)

See *Define Feeder Cable Templates* in the *TEMS CellPlanner Common Features User's Guide*.

Antenna System Templates

One antenna system template can include a multiple number of each of the templates above, for example three antenna templates and two TMA templates.

The final selection of which one of each template to use is done per antenna branch, further described in Define LTE Antenna Branch Template on page 8-13.

See *Define Antenna System Templates* in the *TEMS CellPlanner Common Features User's Guide*.

Radio Repeater Templates (Optional)

See *Define Radio Repeater Templates* in the *TEMS CellPlanner Common Features User's Guide*.

LTE RBS, Sector and Cell Templates

You can save time by using templates for LTE RBSs, sectors and cells in an LTE network plan including:

- many RBSs with the same type of antenna equipment and cell configuration
- many cells with the same cell parameters and antenna branch settings

Define LTE RBS Template

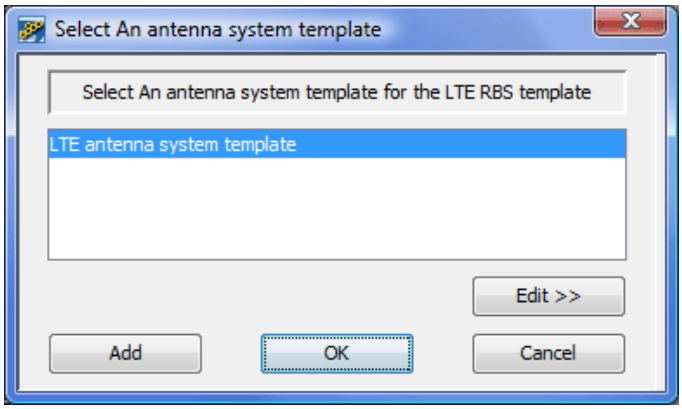
An LTE RBS template includes an antenna system template and optional custom attributes. For a typical three-sector configuration, the LTE RBS template hosts three LTE sector templates, each hosting an LTE cell template and an antenna branch template.

Prerequisites

- An LTE project is opened.
- The antenna system template to use is defined and antenna equipment included in the template, see Antenna System Templates on page 8-5.

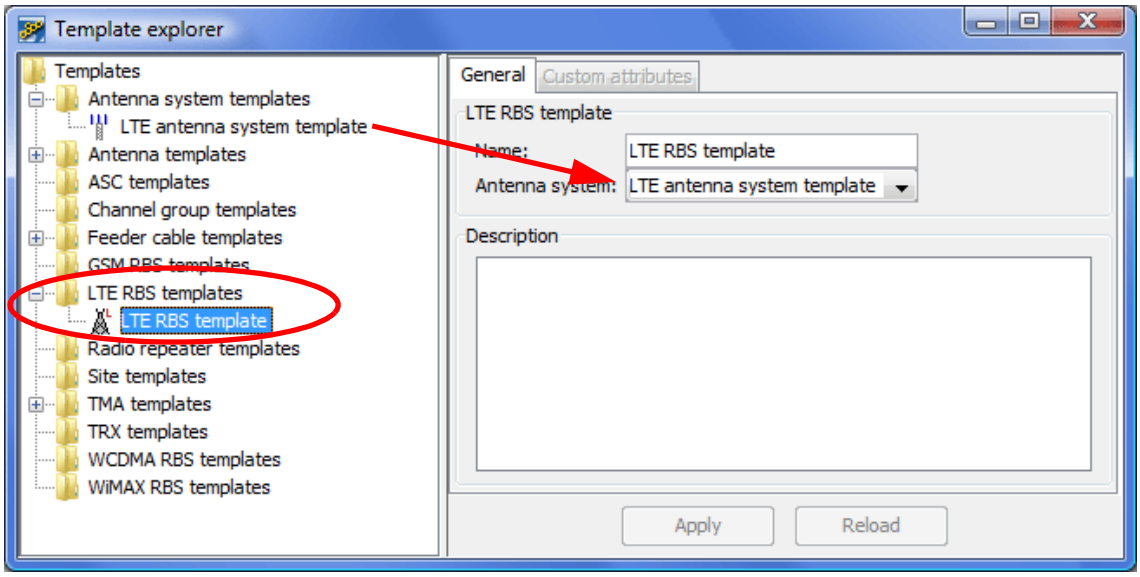
Procedure

1. Select **Utilities↗Template explorer**, and highlight the **LTE RBS templates** folder.
2. Right-click the folder, and select **Add LTE RBS template**. A dialog asking you to select an antenna system template for the RBS template appears:



3. Select an antenna system and click **OK**. The **LTE RBS template** window is displayed.
4. Enter the **Name** of the LTE RBS template.
5. Optionally, enter a description of the LTE RBS template.

6. If you have defined custom attributes for LTE RBS, you can select flag values for the LTE RBS template under the **Custom attributes** tab.
7. Click **Apply** to preserve the LTE RBS template. The result might look as in the following example:



8. Proceed with Define LTE Sector Template.

Fields on Window "LTE RBS Template - General"

Field	Description
Name	Name of the template. Maximum 128 alphabetical or numerical characters. Do not use /,\,' or %.
Antenna system	Antenna system selected for the LTE RBS template
Description	Optional description of the LTE RBS template

Define LTE Sector Template

An LTE sector template is a sub-template of an LTE RBS template. The LTE sector template is strictly associated with the hosting LTE RBS template

The LTE sector template defines among other the frequency band to use. The template hosts an LTE cell template and one or more Tx and/or Rx antenna branches. The antenna branches may be configured as cable repeaters.

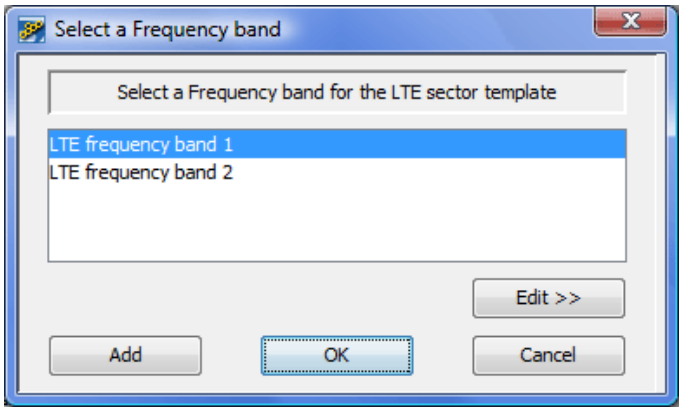
Prerequisites

- An LTE project is opened.

- The LTE RBS template to host the sector template is defined, see Define LTE RBS Template on page 8-6
- The frequency band to use is defined, see Define LTE Frequency Band on page 6-8.

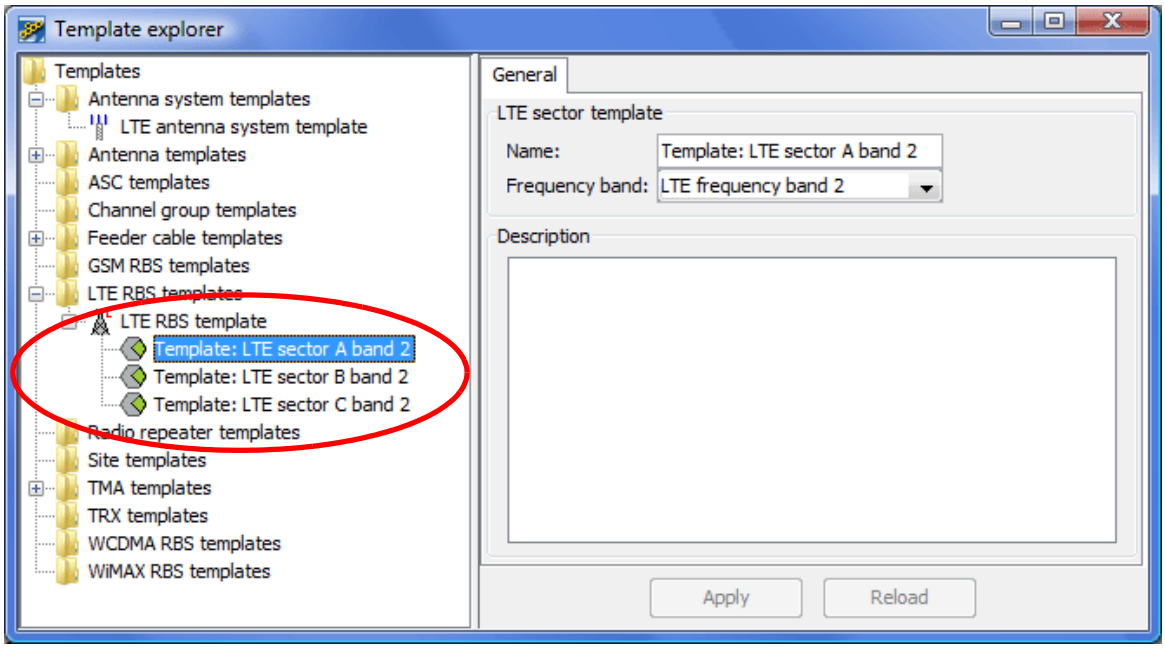
Procedure

1. Select **Utilities↗Template explorer**, and highlight an LTE RBS template.
2. Right-click the LTE RBS template, and select **Add LTE sector template**. A dialog asking you to select a frequency band appears:



3. Select a frequency band and click **OK**. The **LTE sector template** window appears.
4. Enter a **Name** and optionally a **Description** for the template.

5. Repeat the procedure for all sector templates to define. In the example below, templates for three sectors of the same frequency band are defined:



6. Proceed with Define LTE Cell Template and Define LTE Antenna Branch Template for each sector template.

Fields on Window "LTE Sector Template - General"

Field	Description
Name	Name of the template. Maximum 128 alphabetical or numerical characters. Do not use /,\,' or %.
Frequency band	Frequency band selected for the LTE sector template
Description	Optional description of the LTE sector template

Define LTE Cell Template

An LTE cell template is a sub-template of an LTE sector template. All cells using this template will use the same downlink channel number, cell ID and cell ID group, and start index.

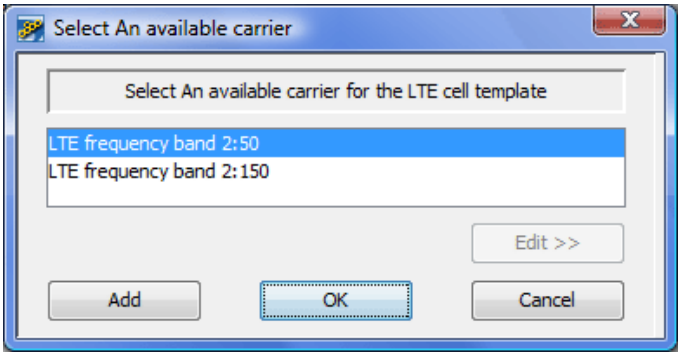
Prerequisites

- An LTE project is opened.
- The LTE sector template to host the cell template is defined, see Define LTE Sector Template on page 8-7.

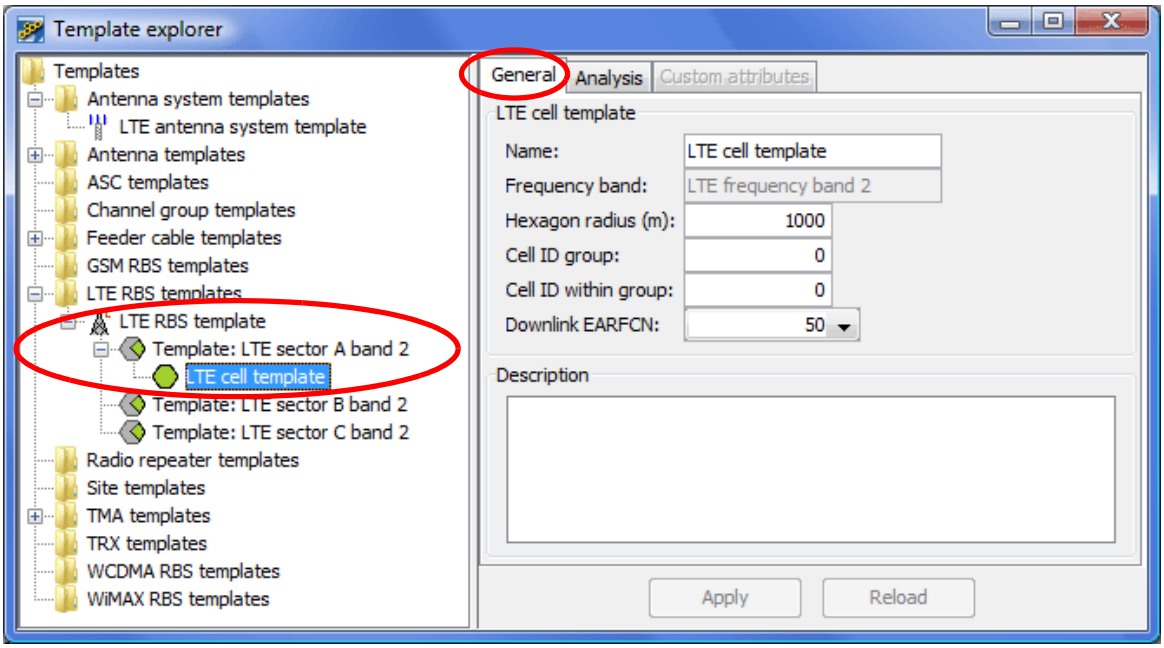
- The frequency band to is defined, see Define LTE Frequency Band on page 6-8.

Procedure

1. Select **Utilities↗Template explorer**, and expand the LTE RBS template to find the sector template.
2. Right-click the sector template, and select **Add LTE cell template**.
   A window requesting you to select a carrier appears:

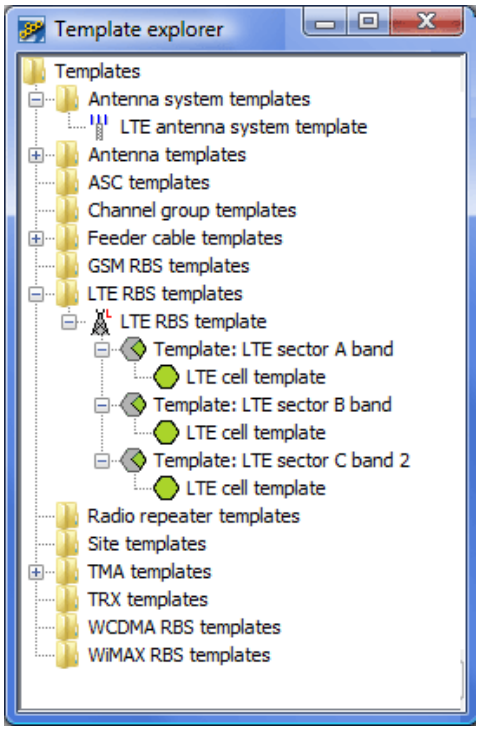


3. The list includes the EARFCNs selectable as carriers within the frequency band of the sector template. Select a **Downlink EARFCN** and click **OK** to display the **LTE cell template - General** window:



4. Enter a **Name** and optionally a **Description** of the template.

5. Modify the general cell parameters as required, see Fields on Window "LTE Cell - General" on page 9-12.
6. Modify the analysis parameters as described in Configure LTE Cell Template Analysis Parameters on page 8-11.
7. Repeat the procedure to create cell templates for all sectors. The result might look as in the following example:



An LTE cell template is only one part of a sector template. To complete the sector template you must also Define LTE Antenna Branch Template for all sectors.

Configure LTE Cell Template Analysis Parameters

Use this procedure to modify the analysis parameters of an LTE cell template.

Prerequisites

- An LTE project is opened.
- The LTE cell template is defined, see Define LTE Cell Template on page 8-9.

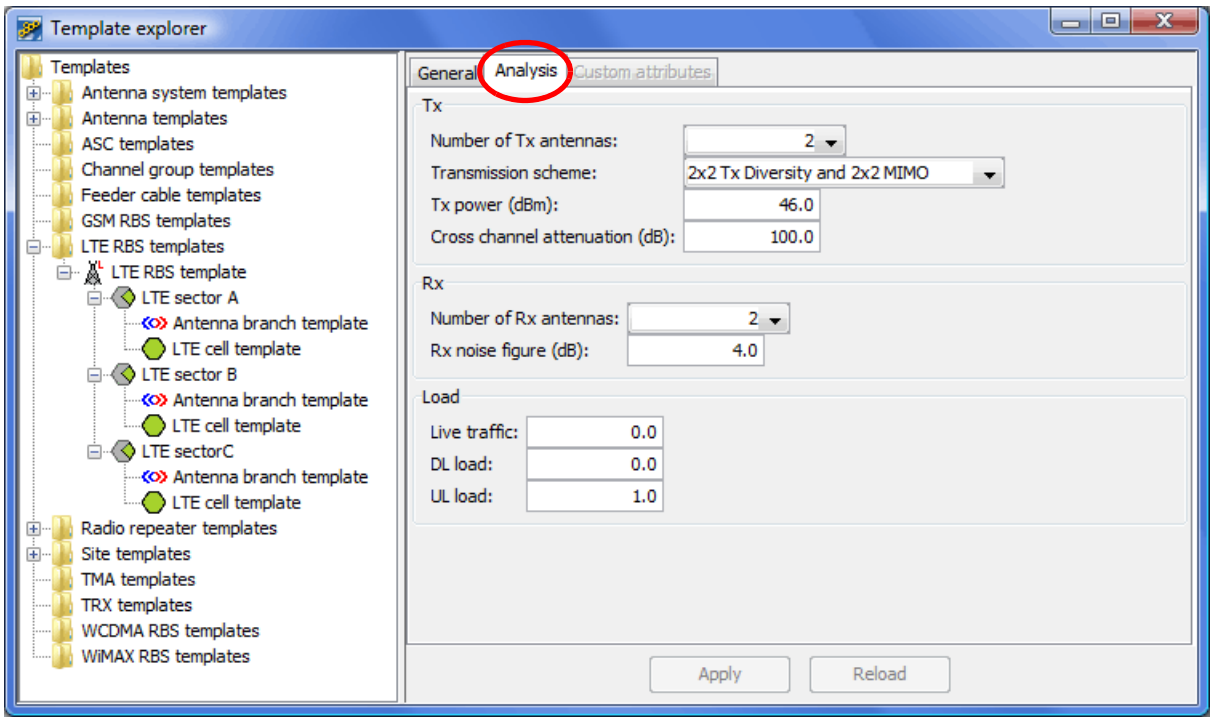
Procedure

Do as follows to modify the analysis parameters of an LTE cell template:

1. Select **Utilities↗Template explorer**.

2. Locate the cell template to modify in the LTE sector template folder, and highlight the cell template. The **LTE cell template** window appears.
3. Select the **Analysis** tab to display the **Analysis** window.
4. Modify the analysis parameters as required, see Fields on Window "LTE Cell - Analysis" on page 9-14. The template parameters are the same as in the actual cell instance.

   In the example below, the parameters are configured to support 2x2 tx diversity and 2x2 MIMO:



5. Click **Apply** to preserve the settings.

LTE Antenna Branch Templates

You can save time by using antenna branch templates when building a network plan with many sites of the same equipment types and propagation models.

Antenna branch templates for LTE sectors and cable repeaters must be created manually, while antenna branch templates for radio repeaters are automatically created when the radio repeater template is created.

Learn about antenna branches in chapter *Antenna Systems and Antenna Branches* in the *TEMS CellPlanner Common Features User's Guide.*

Define LTE Antenna Branch Template

Use this procedure to define an antenna branch template, strictly associated with the hosting LTE sector template.

Prerequisites

The following objects must be defined prior to defining an antenna branch template:

- The LTE sector template to host the antenna branch template, see Define LTE Sector Template on page 8-7.
- The propagation model to include in the antenna branch template, see Propagation Models on page 6-17. You must manually ensure that this propagation model uses the same frequency band as the sector template to use together with the antenna branch template.

  Note: *If your network plan includes fixed subscribers, a PtP (point-to-point) propagation model must be selected as an antenna branch parameter. You may use the same propagation model for mobile UEs and fixed subscribers.*

The following templates may be included in an antenna branch template:

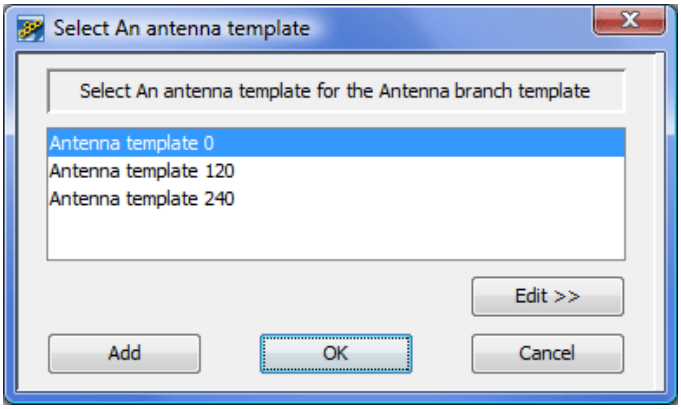
- Antenna Templates (mandatory)
- Antenna System Templates (mandatory)
- TMA Templates (Optional)
- Feeder Cable Templates (Optional)

Procedure

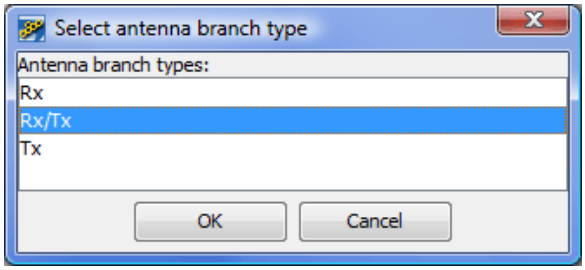
Do as follows to define an antenna branch template for an LTE sector:

1. Select **Utilities↗Template explorer**, and locate the LTE sector template in the **LTE RBS template** folder.

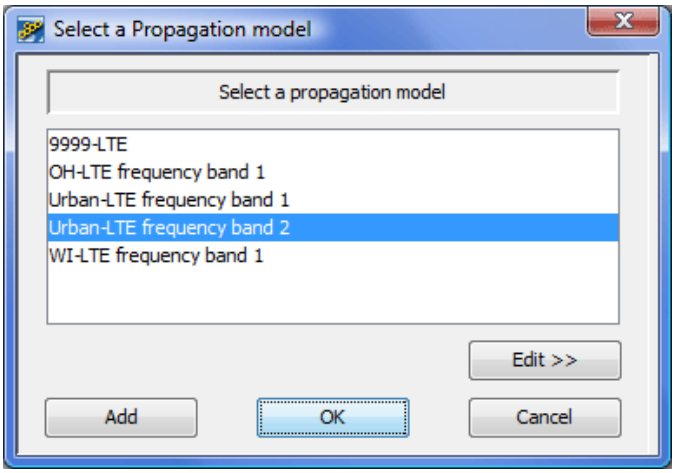
2. Right-click the LTE sector, and select **Add Antenna branch template**. A dialog requesting you to select an antenna template appears:



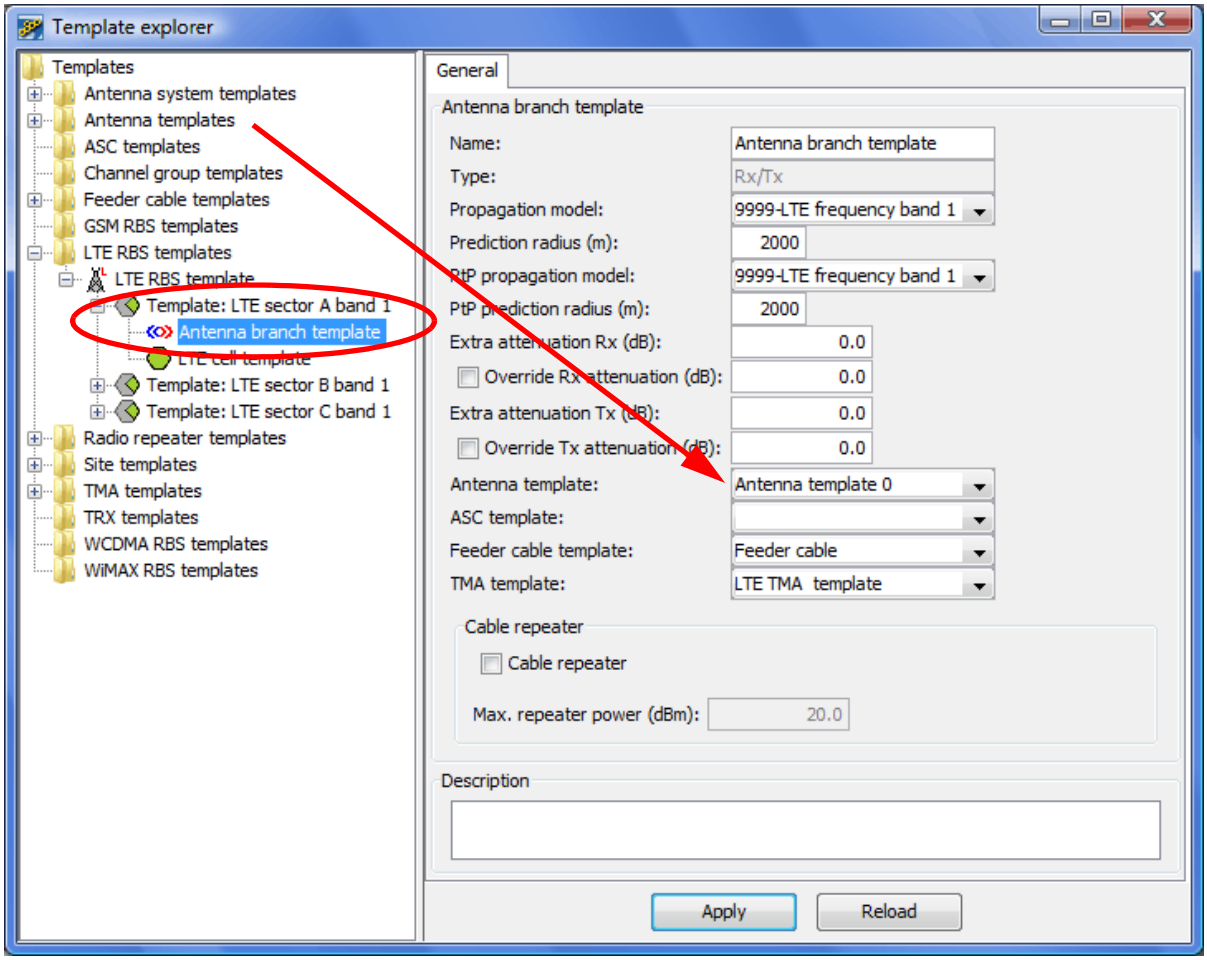
3. Select an antenna template from the list and click **OK**. The **Select antenna branch type** appears:



4. Select to use the antenna branch for duplex Rx/Tx, Rx only or Tx only and click **OK**. The **Select a propagation model** window appears:

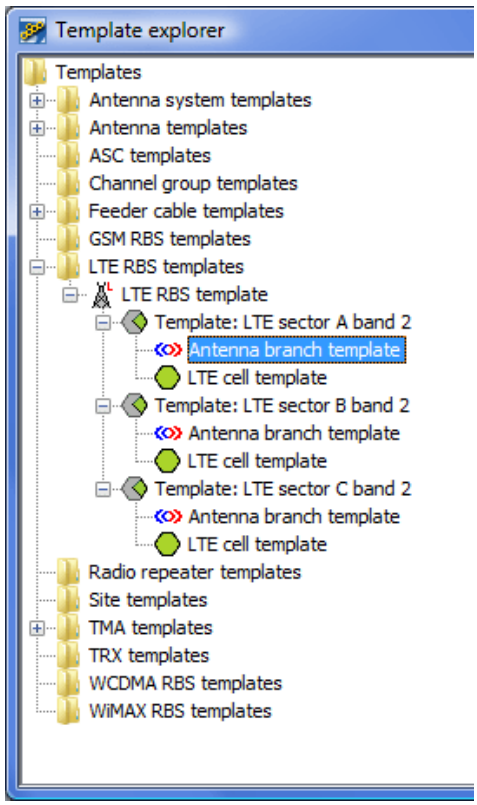


5. Select a propagation model supporting the frequency band of the sector template and click **OK.** The antenna branch is created and the **Antenna branch template** window appears:



6. Select a **PtP propagation model** if fixed subscribers are included in the network plan.
7. Select a feeder cable template if applicable.
8. Select a TMA template if applicable.
9. Change the other parameters as required.
10. Click **Apply** to preserve the antenna branch template as a part of the LTE sector template.

Repeat the procedure for all sector templates needing an antenna branch template. The result then looks as in the following example:



Fields on Window "Antenna Branch Template"

Field	Description
Name	Name of the antenna branch template. Maximum 128 alphabetical or numerical characters. Do not use /,\,' or %.
Type	Transmission/reception type of the antenna branch. • **Rx/Tx** if both receiving and transmitting • **Rx** if receiving only • **Tx** if transmitting only
Propagation model	Propagation model for the cell, selected from a list of defined models.
Prediction radius (m)	The maximum distance from the RBS site to the point of prediction using the **Propagation model**. Range: 0 - 200000. Default = 2000 m.
PtP propagation model	Propagation model for the cell, selected from a list of defined models.
PtP prediction radius (m)	The maximum distance from the RBS site to the point of prediction for fixed LTE devices, using the **PtP propagation model**. Range: 0 - 100000. Default = 2000 m.

Field	Description
Extra attenuation Rx (dB)	Extra UL loss value in decibels, added to the calculated *Total Rx attenuation* in the antenna branch using this template. Range 0 - 50. Default = 0 dB.
Override Rx attenuation (dB)	If selected, the associated attenuation value overrides the *Total Rx attenuation* in the antenna branch using this template. Range: 0 - 100. Default = 0 dB.
Extra attenuation Tx (dB)	Extra DL loss value in decibels, added to the calculated *Total Tx attenuation* in the antenna branch using this template. Range 0 - 50. Default = 0 dB.
Override Tx attenuation (dB)	If selected, the associated attenuation value overrides the *Total Tx attenuation* in the antenna branch using this template. Range: 0 - 100. Default = 0 dB.
Antenna template	Antenna template associated with the antenna branch
ASC template	Antenna system controller (ASC) template. Not used in LTE network plans.
Feeder cable template	If applicable, feeder cable template associated with the antenna branch.
TMA template	If applicable, tower mounted antenna (TMA) template associated with the antenna branch.
Cable repeater:	
Cable repeater	Enables use of the cable repeater parameters. If this option is selected, the Tx power parameter of the cell created from this template inherits the **Max. repeater power** from the cable repeater instead of the cell's Tx power. Recommended: Give the antenna branch a name clearly showing it is a cable repeater antenna branch.
Max. repeater power (dBm)	Cable repeater transmitted power. Used if the **Cable repeater** option is selected. Range -40.0 - 80.0 dBm. Default = 20 dBm.
Description	Optional description of the antenna branch template

Site Templates

Site templates save you time when defining many sites of the same properties.

Define LTE RBS Site Template

Create a site template and associate it with an LTE RBS template.

See *Define Site Templates* in the *TEMS CellPlanner Common Features User's Guide*.

Define LTE Fixed Subscriber Template

Create a site template and associate it with up to 15 LTE fixed subscriber profiles.

See *Define Site Templates* in the *TEMS CellPlanner Common Features User's Guide*.

Define Radio Repeater Site Templates (Optional)

Create a site template and associate it with a radio repeater template.

See *Define Site Templates* in the *TEMS CellPlanner Common Features User's Guide*.

9
LTE Sites, RBSs, Sectors, Cells and Networks

This chapter describes how to define the sites with their network elements - LTE RBSs with sectors, antenna branches and cells - in an LTE network plan.

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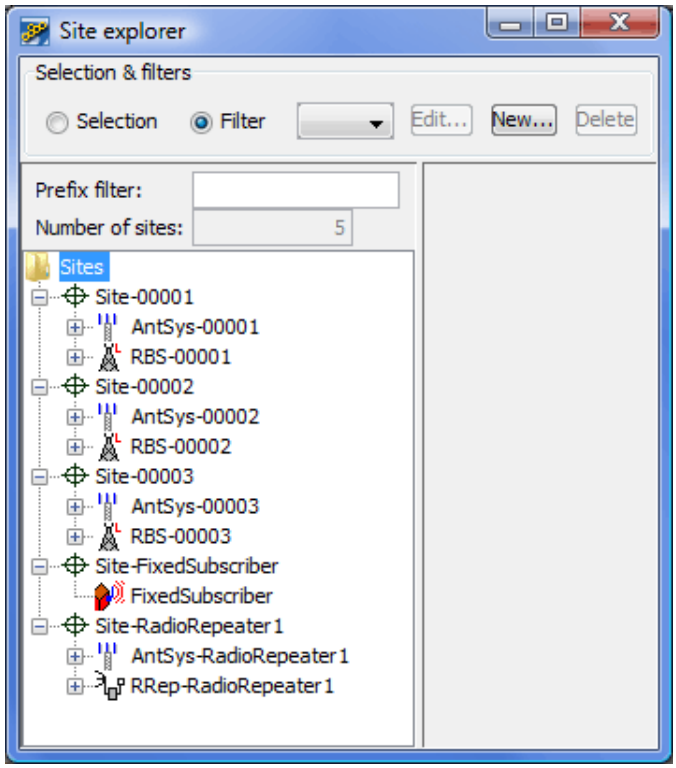
About LTE Sites

Before analyzing a network plan you shall add actual sites with their equipment and place them geographically in the network.

An LTE network may include

- LTE RBS sites
- multi-technology RBS sites (LTE RBS co-sited with RBS of other technology)
- LTE fixed subscriber sites for non-mobile LTE terminals
- radio repeater sites amplifying the radio signals

A site configuration with three RBS sites, one fixed subscriber site, and one radio repeater site is illustrated in the example below:



Define Sites in an LTE Network Plan - Step by Step

The typical order of defining sites in an LTE network is reflected in the lists below and in the order of procedures in this chapter.

Fixed subscribers are defined as sites as they have fix positions in the network.

You can create sites directly from site templates:

❶ LTE RBS sites see Create Site Using LTE RBS Site Template

❷ LTE fixed subscriber sites see Create Site Using LTE Fixed Subscriber Template

...or alternatively you can first create sites and then add underlying objects, where LTE RBSs and its underlying objects may be based on templates:

❶ Sites see
- Add Sites

❷ LTE RBSs see
- Add LTE RBS to a Site (Create From Template) or Add LTE RBS to a Site (Add Without Template)
- Add Antenna System to a Site
- Add LTE Sector to an LTE RBS
- Add Antenna Branch to an LTE Sector
- Add LTE Cell to an LTE sector
- Configure LTE Cell Analysis Parameters
- Select Neighbor Cells
- Select Custom Attributes for LTE Cells

❸ LTE fixed subscribers see
- Add Antenna System to a Site
- Add LTE Fixed Subscriber to a Site (Without Template)

LTE RBS Sites

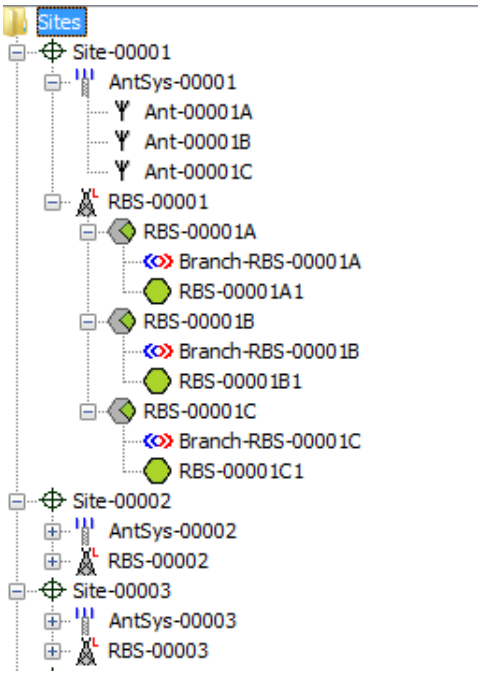
An LTE RBS models an enhanced NodeB (eNodeB).

A pure LTE RBS site includes the following network elements:

- One antenna system with antennas, optionally with feeder cable and TMA
- One LTE RBS hosting up to eight (8) sectors, each with one cell and one antenna branch

You can add, modify and delete sites and their underlying objects using the **Site explorer** or the **LTE RBS explorer**.

The first site in the example below includes one antenna system with antennas, feeder cable and TMA, and one LTE RBS with three sectors.



The quickest method to create similar LTE RBS sites is to add the sites using an already defined LTE RBS template, as described in Create Site Using LTE RBS Site Template. All underlying objects are then added automatically.

Another quick method is to first Add Sites, and then add LTE RBSs from templates, as described in Add LTE RBS to a Site (Create From Template). All underlying objects are added automatically.

A more tedious method is to first Add Sites, then add the LTE RBS without using a template, and add an antenna system manually. How to do is described in procedure Add LTE RBS to a Site (Add Without Template), and in *Add Antenna System to a Site (Add Without Template)* in the *TEMS CellPlanner Common Features User's Guide*.

Create Site Using LTE RBS Site Template

The quickest way to create similar LTE RBS sites is to add the sites using an already defined LTE RBS site template. The sectors and cells with antenna branches included in the LTE RBS site template are added automatically.

The antenna system of the chosen system type is also automatically added to the site, thus no antenna system need to be explicitly added to the site.

Prerequisites

- The LTE RBS site template is defined, see Define LTE RBS Site Template on page 8-18
- The antenna system template is defined, see Antenna System Templates on page 8-5.
- Antenna-related equipment is included in the antenna system template, see Antenna Equipment Templates on page 8-5.

Procedure

Follow these steps to create an LTE RBS site with all its underlying objects:

1. Select **Utilities↗Site explorer**.
2. Right-click on the top object **Sites**, select **Add Site using↗LTE RBS site template**, and select the appropriate template. The **Site** window is displayed.
3. Set the site's position and ground height as in Add Sites on page 9-5.
4. If needed, modify parameters of the underlying objects, as in the following procedures (but skip the "Add"):
   - Add Antenna System to a Site
   - Add LTE RBS to a Site (Add Without Template)
   - Add LTE Sector
   - Add Antenna Branch to an LTE Sector
   - Add LTE Cell
   - Configure LTE Cell Analysis Parameters
   - Select Neighbor Cells
   - Select Custom Attributes for LTE Cells

Add Sites

You can add LTE RBS Sites, multi-technology RBS sites, and radio repeater sites to your network plan by placing them geographically in your planning area.

See *Add Sites* in the *TEMS CellPlanner Common Features User's Guide*.

Add LTE RBS to a Site (Create From Template)

The most efficient way to add an LTE RBS to an existing site is to add the LTE RBS to the site from an already defined LTE RBS template. The sectors and cells with antenna branches included in the LTE RBS template are added automatically.

The antenna system of the chosen system type is also automatically added to the site, thus no antenna system need to be explicitly added.

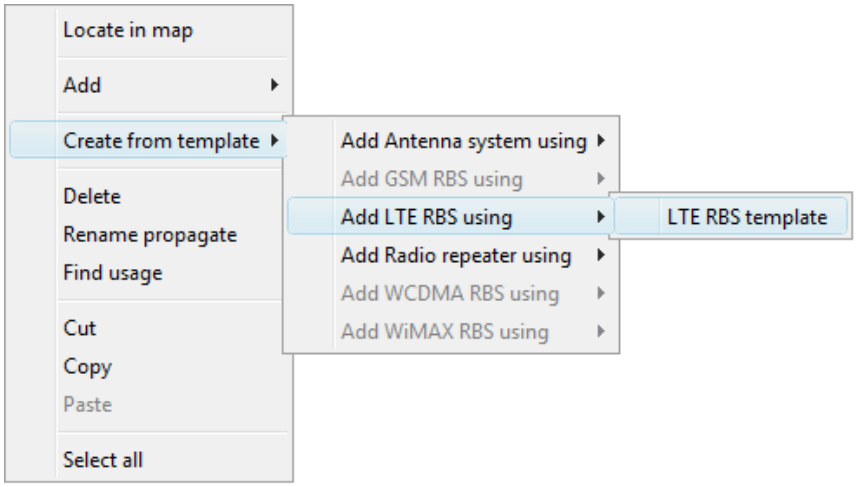
Prerequisites

- The site to host the LTE RBS is created, see Add Sites.
- The LTE RBS template to use is defined, see Define LTE RBS Template
- The antenna system template is defined, see Antenna System Templates.
- Antenna-related equipment is included in the antenna system template, see Antenna Equipment Templates.

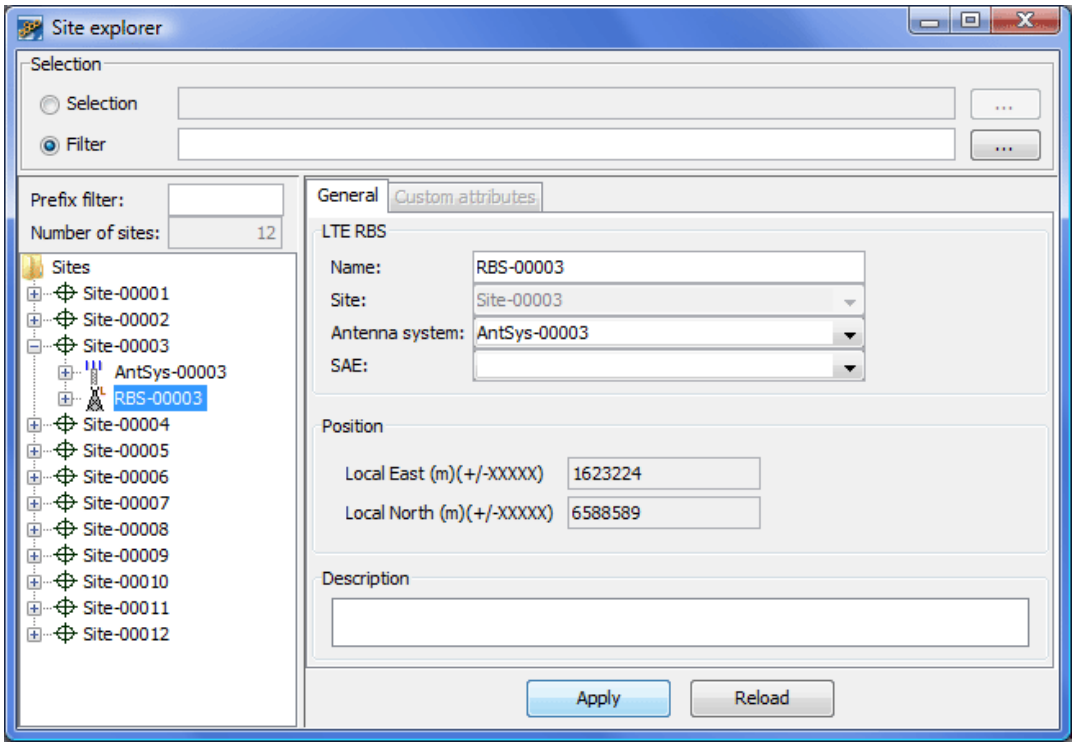
Procedure

Follow these steps to add an LTE RBS and all its network elements to a site:

1. Select **Utilities↗Site explorer**. A list of sites is displayed.
2. Optionally delimit the number of listed sites by a selection or filter.
3. Locate the site in the browser, right-click on the site, click **Create from template↗Add LTE RBS using** and select a template as in the following example:



4. An antenna system and LTE RBS with underlying network elements are created from the template and appear under the site. The **LTE RBS - General** window appears as in the following example:



5. Modify the **Name** of the RBS if required.
6. If you have defined custom attributes for LTE RBS, you can select flag values for this specific LTE RBS under the **Custom attributes** tab.
7. Click **Apply** to preserve the settings.

Fields on Window "LTE RBS"

The fields on the LTE RBS windows are described in the following table:

Field	Description
Name	Name of the LTE RBS. Maximum 128 alphabetical or numerical characters. Do not use /,\,' or %.
Site	The site hosting the LTE RBS. Not editable.
Antenna system	Antenna system for the LTE RBS, inherited from the template.
SAE	Selected SAE node, requires that the SAE is defined.
Position	The position of the RBS, inherited from the site. Not editable.
Description	Optional description of the site

Add LTE RBS to a Site (Add Without Template)

Instead of using an LTE RBS template, an LTE RBS can be added in a more "raw" way to the site. You then add first the LTE RBS and subsequently all its underlying objects one by one.

Prerequisites

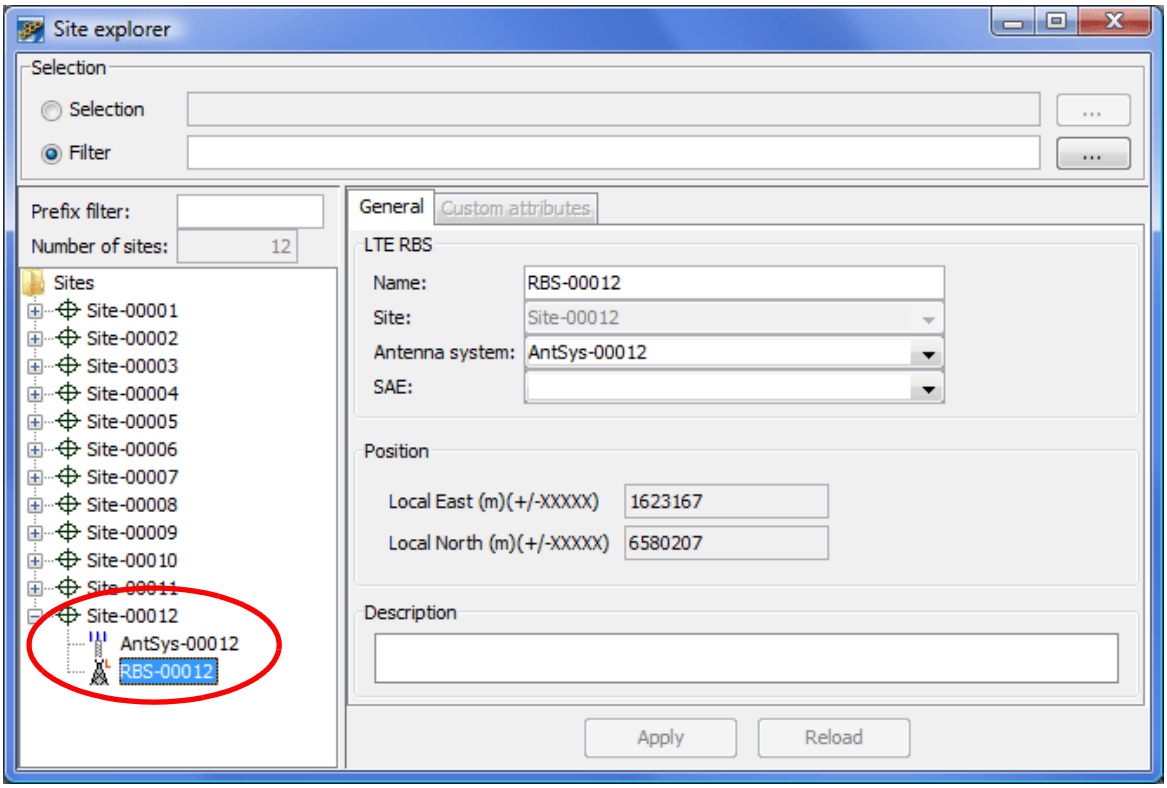
The site to host the LTE RBS is defined, see Add Sites on page 9-5.

Procedure

Follow these steps to add an LTE RBS to a site:

1. Select **Utilities↗Site explorer.** A list of sites is displayed.
2. Optionally delimit the number of listed sites by a selection or filter.
3. Locate the site in the browser, right-click on the site and select **Add↗LTE RBS**.
4. If the site has no antenna system, the **Select an antenna system** dialog appears. Click **Add**. An empty antenna system is added to the site.
5. Select an antenna system and click **OK**.
6. An empty LTE RBS is created under the site and the **LTE RBS - General window** appears.
7. Modify the **Name** of the RBS if required.
8. If you have defined custom attributes for LTE RBS, you can select flag values for this specific LTE RBS under the **Custom attributes** tab.

9. Click **Apply** to preserve the settings. The site in the example contains an empty antenna system and an LTE RBS without sectors:



10. Proceed with adding antenna equipment to the antenna system and Add LTE Sector to add the desired number of sectors to the RBS.

Fields on the Window

See Fields on Window "LTE RBS" on page 9-7.

Add LTE Sector

You can add up to eight (8) LTE sectors to each LTE RBS.

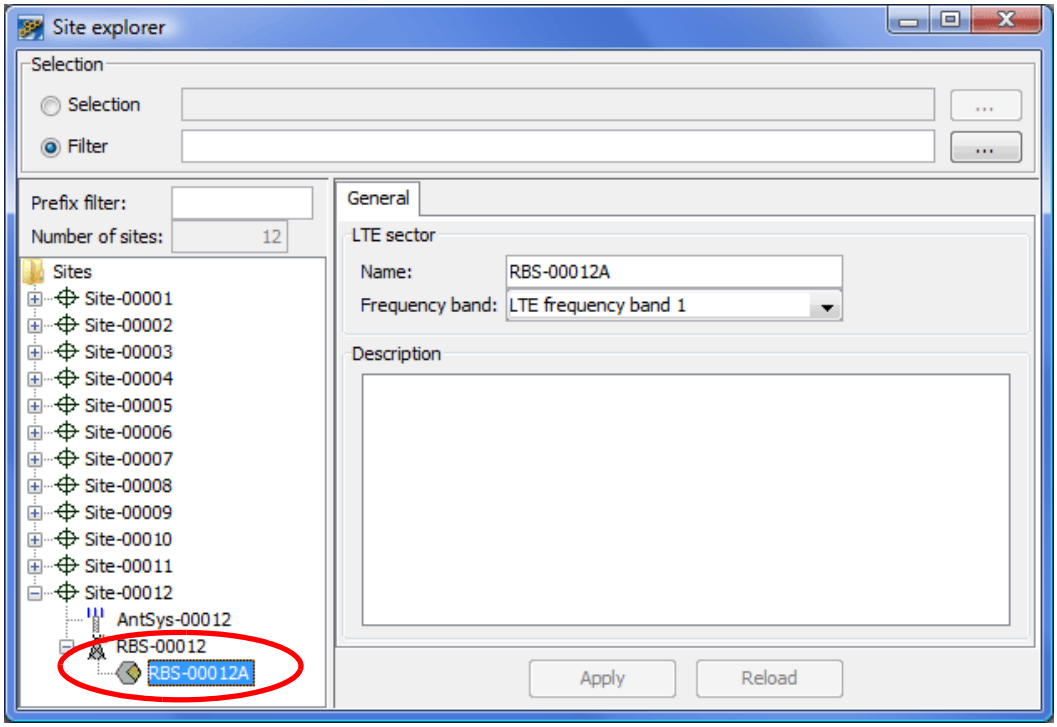
Prerequisites

- The RBS of the cell is defined, see Add LTE RBS to a Site (Add Without Template).
- The frequency band to use is defined, see Define LTE Frequency Band.

Procedure

Follow these steps to add an LTE sector to an LTE RBS:

1. Select **Utilities↗Site explorer** or **Utilities↗LTE RBS explorer**. A list of sites or LTE RBSs is displayed.
2. Optionally delimit the number of sites or LTE RBSs by a selection or filter.
3. Right-click an RBS in the tree and select **Add LTE sector** from the menu. The **Select a frequency band** window appears.
4. Select a frequency band from the list.
5. Click **OK**. The **LTE sector** window is displayed as in the following example:



6. Modify parameters as required, and click **Apply** to preserve the settings.
7. Proceed with adding cells as described in Add LTE Cell.

Fields on Window "LTE sector"

The fields on the LTE sector window are described in the following table:

Field	Description
Name	Name of the cell. Maximum 128 alphabetical or numerical characters. Do not use /,\,' or %.
Frequency band	Frequency band of the cell
Description	Description of the cell

Add LTE Cell

You can add up to four (4) LTE cells to an LTE sector.

An LTE cell can host up to eight (8) antenna branches, optionally some of them defined as cable repeaters.

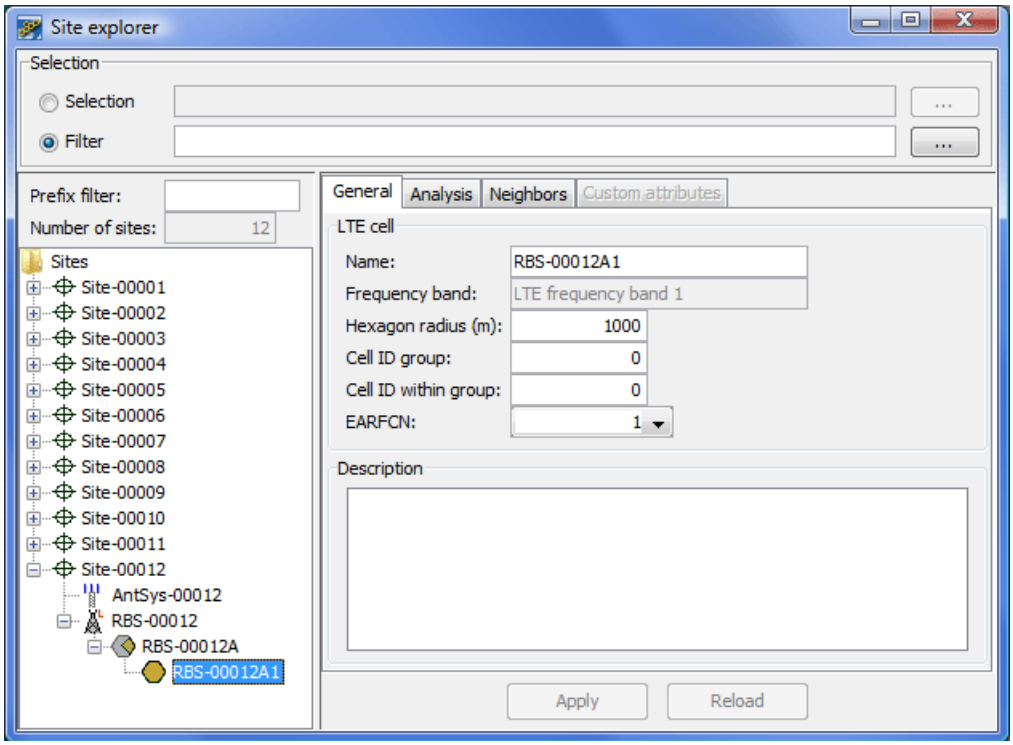
Prerequisites

- The LTE sector to host the cell is defined, see Add LTE Sector.
- Carriers are defined, see Select LTE Carrier Channels.

Procedure

Follow these steps to add an LTE cell to an LTE sector:

1. Select **Utilities↗Site explorer** or **Utilities↗LTE RBS explorer**. A list of sites or LTE RBSs is displayed.
2. Optionally delimit the number of sites or LTE RBSs by a selection or filter.
3. Right-click an LTE sector in the tree and select **Add LTE cell** from the menu. The **Select an available carrier** dialog appears.
4. Select a carrier from the list and click **OK**. The LTE cell object is created, and the EARFCN in the frequency band is assigned as carrier in the cell. The **LTE cell - General** window is displayed, showing the selected **Carrier number**:



5. Modify the **Hexagon radius** if required.
6. Select a **Cell ID group** and a **Cell ID within group**.

   Note: *You can later perform an automatic* Cell ID Planning*.*

7. Click **Apply** to preserve the settings.
8. Proceed with Configure LTE Cell Analysis Parameters and Add Antenna Branch to an LTE Sector.

Fields on Window "LTE Cell - General"

Field	Description
Name	Maximum 128 alphabetical or numerical characters. Do not use /,\,' or %.
Frequency band	Frequency band of the cell, selected in Add LTE Sector. Not editable.
Hexagon radius (m)	The hexagon radius of a nominal site as displayed on the map. Range: 1 - 100000. Default = 1000 m.
Cell ID group	The combination of **Cell ID group** and **Cell ID** within group is used by terminals to distinguish between cells belonging to different RBSs but transmitting on the same downlink EARFCN. These parameters may instead be automatically planned, see Cell ID Planning on page 15-2. Cell ID group range: 0 - 167, default = 0. Cell ID range: 0 - 2, default = 0.
Cell ID within group	
EARFCN	Downlink LTE absolute radio frequency channel number. Selected from EARFCNs defined in Select LTE Carrier Channels.
Description	Optional description.

Configure LTE Cell Analysis Parameters

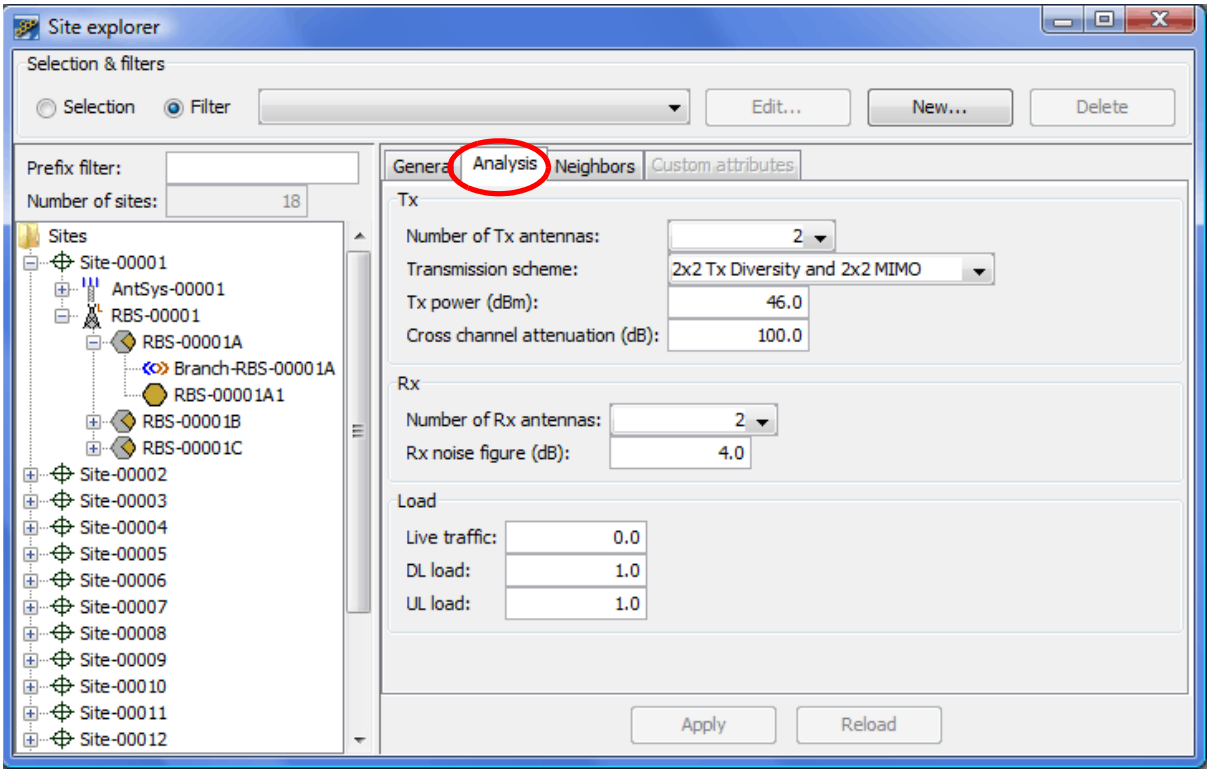
Use this procedure to configure analysis information of an LTE cell.

Prerequisites

The LTE cell is added to the RBS, see Add LTE Sector.

Procedure

1. Select **Utilities↗Site explorer** or **Utilities↗LTE RBS explorer**. A list of sites or LTE RBSs is displayed.
2. Optionally delimit the number of sites or LTE RBSs by a selection or filter.
3. Locate the LTE cell in the tree and select it.
4. Select the **Analysis** tab. The **LTE cell - Analysis** window appears:



5. Modify the parameters as required.
6. Click **Apply** to preserve the settings.

Fields on Window "LTE Cell - Analysis"

The table below describes the fields on the LTE cell analysis window:

Field	Description
Tx	
Number of Tx antennas	1 = ordinary antenna (default) 2 = 2x2 MIMO antenna and/or 2x2 Tx diversity
Transmission scheme	Depends on **Number of Tx antennas**. • 1x2 MRC (default for 1 Tx antenna) • 2x2 Tx diversity (default for 2 Tx antennas, selectable for 2 Tx antennas only) • 2x2 Tx diversity and 2x2 MIMO (selectable for 2 Tx antennas only)
Tx power (dBm)	Transmit power of tx antennas. Adjusts the power according to the **Number of Tx antennas**. Range: 0 - 60. Initial value = 43 dBm (one antenna). Suitable initial value for two antennas is 46 dBm.
Cross channel attenuation (dB)	The DL attenuation added to pathloss for the unwanted antenna causing DL interference. Used for MIMO antennas with multiple **Number of Tx antennas**. Compensates for the fact that use of one data stream only (out of two) is not always perfect. Range: 0 - 100. Default = 100 dB (full attenuation). ***Note:*** *Full attenuation (100 dB) is already taken into account in all channel models configured for the terminal types.*
Rx	
Number of Rx antennas	1 = ordinary antenna 2 = 2x2 MIMO antenna (but UL SIMO will be used) 4 = 2x4 MIMO antenna (not yet implemented) ***Note:*** *SIMO (1x2 MRC) is always used in UL as UL MIMO is not implemented* ***Note:*** *4 Rx antennas are selectable, but the algorithms presently support only 2 Rx antennas*
Rx noise figure (dB)	The ratio of receiver noise to thermal noise level. The receiver noise is caused by incompleteness in the receiver. Range: 0 - 15. Default = 4 dB.
Load	
Live traffic	Number of terminals from live traffic spreading. Range = 0 - 100000. Default = 0.
DL load	Downlink load on this cell. Input to LTE Analysis (Including Interference) which calculates the actual DL utilization and feeds this value back to the cell configuration. The configured DL load value is overwritten by a calculated value. Range: 0 - 1. Default = 1 (100%).
UL load	Uplink load on this cell. Input to LTE Analysis (Including Interference) which calculates the actual UL utilization and feeds this value back to the cell configuration. The configured UL load value is overwritten by a calculated value. Range: 0 - 1. Default = 1 (100%).

Configure MIMO

Do as follows to configure a network plan to include 2x2 MIMO.

Configure Terminals for Cells Supporting 2x2 MIMO

Select spectral efficiency technique open-loop MIMO or closed-loop MIMO for each terminal type by selecting a Data Rate Mapping supporting the desired technique. See Define LTE Terminal Type on page 7-5.

Configure Cells for 2x2 MIMO

The parameters in the cells' analysis tab shall have the following values:

- Number of Tx antennas = 2
- Transmission scheme = 2x2 Tx diversity and 2x2 MIMO
- Tx power = 46 dBm (suitable value for 2 Tx antennas)
- Number of Rx antennas = 2

See Configure LTE Cell Template Analysis Parameters (optional) and Configure LTE Cell Analysis Parameters.

2x2 MIMO in Analysis

Run the LTE Analysis (Including Interference). When terminals are connected to cells supporting 2x2 MIMO, the spectral efficiency technique selected for the terminal type is applied. As cells supporting 2x2 MIMO also support 2x2 Tx diversity, the simulated connections dynamically switch to 2x2 Tx diversity when this is favorable compared to 2x2 MIMO, just as in a live network.

MIMO related plots:

- DL MIMO Data Rate Gain
- DL Transmission Scheme

Configure Tx Diversity Without MIMO

Do as follows to configure the network plan for 2x2 Tx diversity.

Configure Terminals for Cells Supporting 2x2 Tx Diversity

No special terminal configuration is needed. The spectral efficiency technique (open-loop or closed-loop MIMO) will be ignored by terminals connected to cells that do not support MIMO.

Configure Cells for 2x2 Tx Diversity

The parameters in the cells' analysis tab shall have the following values:

- Number of Tx antennas = 2
- Transmission scheme = 2x2 Tx diversity
- Tx power = 46 dBm (suitable value for 2 antennas)
- Number of Rx antennas = 2

See Configure LTE Cell Template Analysis Parameters (optional) and Configure LTE Cell Analysis Parameters.

Tx Diversity in Analysis

Run the LTE Analysis (Including Interference). When terminals are connected to cells supporting as most 2x2 Tx diversity, that transmission scheme will be used.

Tx diversity related plots:

- DL MIMO Data Rate Gain
- DL Transmission Scheme

Configure 1x2 MRC (SIMO)

Do as follows to configure the network plan for 1x2 MRC (SIMO):

Configure Terminals for Cells Supporting 1x2 MRC (SIMO)

No special terminal configuration is needed. The spectral efficiency technique (open-loop or closed-loop MIMO) will be ignored by terminals connected to cells that do not support MIMO.

Configure Cells for 1x2 MRC (SIMO)

The parameters in the cells' analysis tab shall have the following values:

- Number of Tx antennas = 1
- Transmission scheme = 1x2 MRC (the only choice for 1 Tx antenna)
- Tx power = 43 dBm (suitable value for 1 Tx antenna)
- Number of Rx antennas = 2

See Configure LTE Cell Template Analysis Parameters (optional) and Configure LTE Cell Analysis Parameters.

1x2 MRC (SIMO) in Analysis

Run the LTE Analysis (Including Interference). When terminals are connected to cells supporting as best SIMO, that transmission scheme will be used.

SIMO related plot: DL Transmission Scheme

Select Neighbor Cells

Chapter Neighbors in the *TEMS CellPlanner Common Features User's Guide* **contains a more up-to-date description on how you can add, modify and delete neighbors. The descriptions below will be aligned in a later release.**

You can use the **LTE cell** window, tab **Neighbors**, to add or delete neighbor cells to LTE cells. The neighbor information is not used in the analysis, but may be exported or used in Cell ID Planning.

Note: *The neighbors you select here are not evaluated from a handover perspective. To ensure that relations can be used for handover you should instead use the* ***Analysis*** *menu to* Generate LTE Neighbor Lists *where handover margins are considered.*

Prerequisites

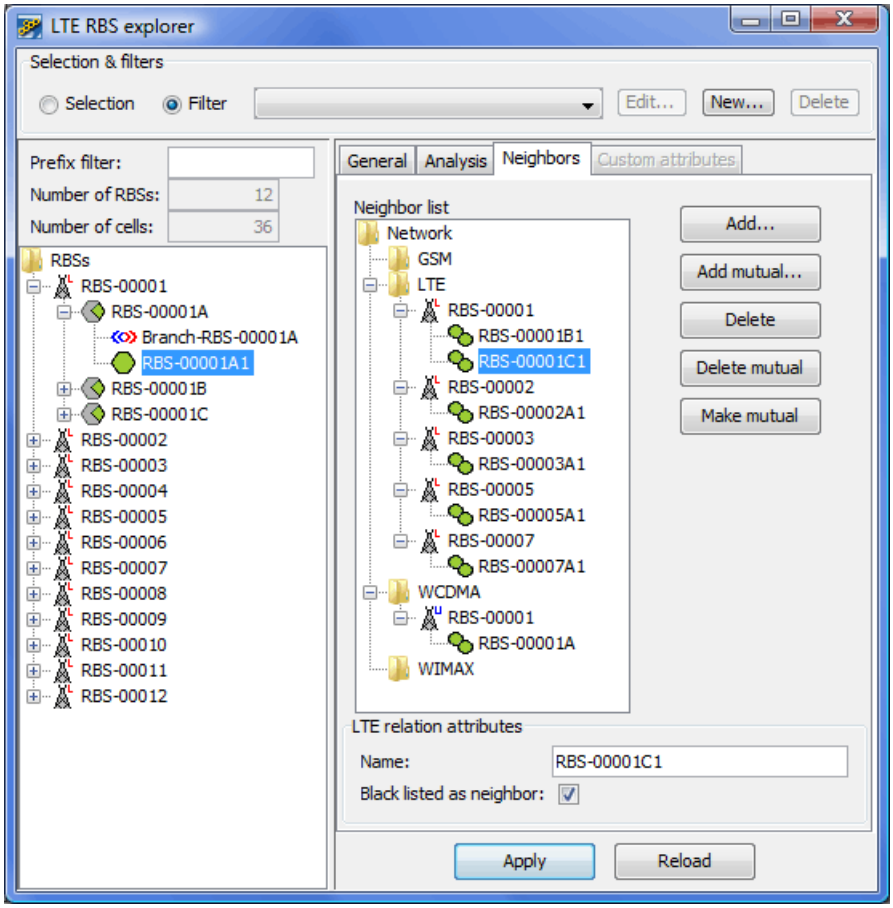
- The LTE target cell is defined, see Add LTE Cell on page 9-11.
- The LTE, WCDMA or GSM cells to add as neighbors are defined.

Procedure

Follow these steps to manually add neighbors to an LTE cell:

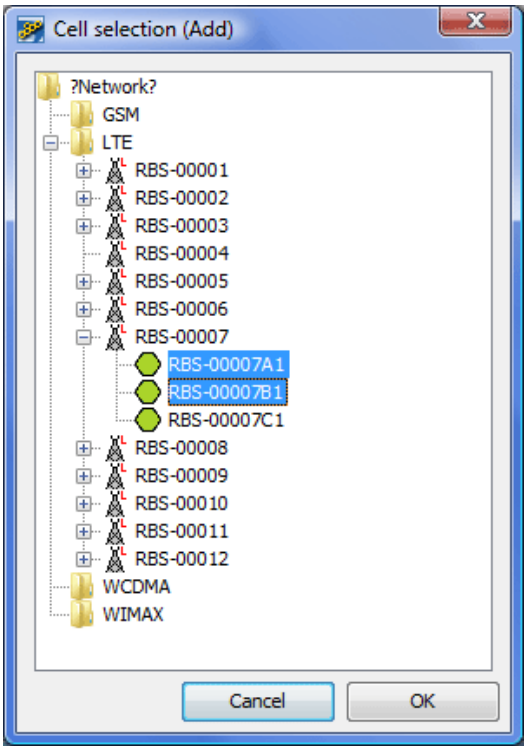
1. Use the **Site explorer** or the **LTE RBS explorer** to select the target cell.
2. Select the **Neighbors** tab.

3. In the **Neighbor list** window, highlight the target cell as in the example below:



4. Click **Add**. The **Cell selection (Add)** window with possible neighbors appears.
5. To instead add two-way relations, select **Add mutual**. A similar window named **Cell selection (Add mutual)** is opened. The procedure for adding mutual relations is the same as for one-way relations.

6. Highlight the cell(s) to add as neighbors, as in the example below:



7. Click **OK**. The **Neighbor list** in previous window is updated.

Fields on Window "Neighbor List"

Field	Description
Neighbor list	Shows the neighbors for a cell, organized by technology and then by RBS. Mutual cell relationships are displayed with a double green cell icon. Non-mutual relationships are displayed with a green/white cell icon. The list indicates when the relation is mutual, meaning that the origin cell is also included on the neighbor list of the target cell.
Add...	Displays the **Cell selection (Add)** window for adding neighbor cells to the highlighted cell. Makes the cell relationship non-mutual.
Add mutual...	Displays the **Cell selection (Add mutual)** window for adding a mutual cell neighbor relationship.
Delete	Deletes a neighbor relationship from a cell.
Delete mutual	Deletes a mutual relationship from the original cell and its neighbor.
Make mutual	Makes a cell relationship mutual between two cells.
Name	Name of selected target cell, that is, the cell to which neighbors shall be added or deleted.
Blacklisted as neighbor	LTE specific option. The cell may not be used as a neighbor.

Show Neighbor Cells on Map Display

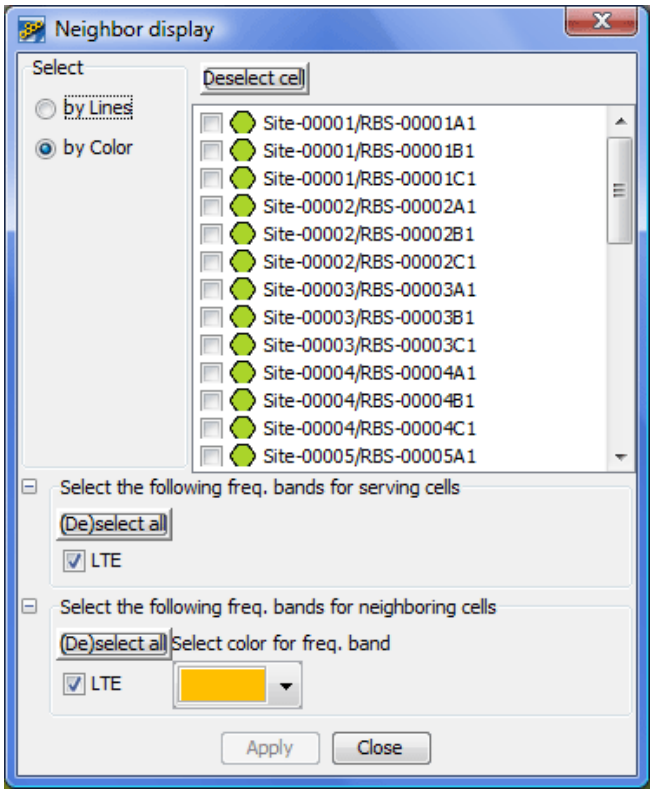
Chapter Neighbors in the *TEMS CellPlanner Common Features User's Guide* **contains a more up-to-date description on how you can add, modify and delete neighbors. The descriptions below will be aligned in a later release.**

You can show the neighbor cells of a selected cell on the map display, either by color marking the neighbor cells, or by drawing lines to the neighbor cells.

Procedure

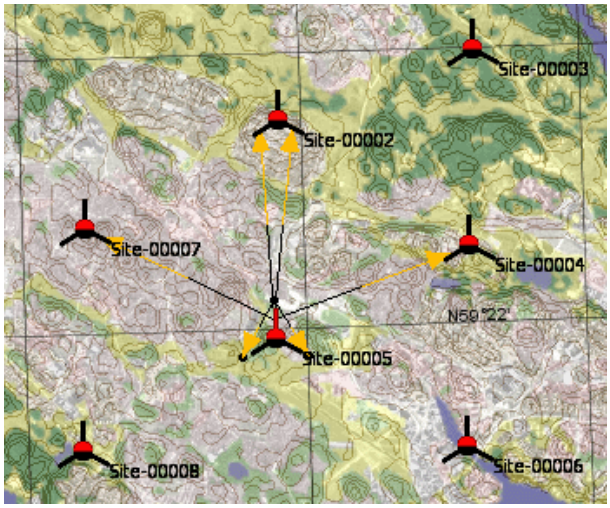
Do as follows to view neighbor cells on the map display:

1. Select Analysis↗Neighbor display. The Neighbor display window appears as in the following example:



2. Select a cell for which to show the neighbors.
3. Select the color for showing neighbor relations or marking neighbor cells.
4. To show the neighbor relations as lines, select by Lines.
5. To color mark the neighbor cells, select by Color.

6. Click **Apply.** The result might look in the following example, where neighbors are marked by lines:



Fields on Window "Neighbor display"

Field	Description
Select by lines	Map display window shows neighbor relations by lines connecting cells/sectors. The arrows indicate mutuality or one-way relation.
Select by color	Map display window shows neighbor cells by colors.
Frequency bands for serving cells	Frequency bands of the serving cells to display.
Frequency bands for neighboring cells	Frequency bands of the neighboring cells to display.

Select Custom Attributes for LTE Cells

If you have defined custom attributes for LTE cell, you can select flag values for specific LTE cells under the **Custom attributes** tab. Read more about custom attributes and flag types in the *TEMS CellPlanner Common Features User's Guide*.

LTE Fixed Subscriber Sites

An LTE fixed subscriber models a stationary LTE terminal.

The quickest method to create similar LTE fixed subscriber sites is to add sites using an already defined LTE fixed subscriber template, as described in Create Site Using LTE Fixed Subscriber Template.

An alternative method is to first Add Sites, then Add LTE Fixed Subscriber to a Site (Without Template).

Create Site Using LTE Fixed Subscriber Template

The quickest way to create similar LTE fixed subscriber sites is to add the sites using an already defined LTE fixed subscriber template.

Prerequisites

The LTE fixed subscriber template is defined, see Define LTE Fixed Subscriber Template on page 8-18.

Procedure

Follow these steps to create an LTE fixed subscriber site from a template:

1. Select **Utilities↗Site explorer**.
2. Right-click on the top object **Sites**, select **Add Site using↗LTE fixed subscriber template**, and select the appropriate template. The **Site** window is displayed.
3. Set the site's position and ground height as in Add Sites on page 9-5.
4. If needed, modify the parameters of the fixed subscriber, see Fields on Window "LTE fixed subscriber" on page 9-23.

Add LTE Fixed Subscriber to a Site (Without Template)

You can add up to 15 LTE fixed subscribers to a site.

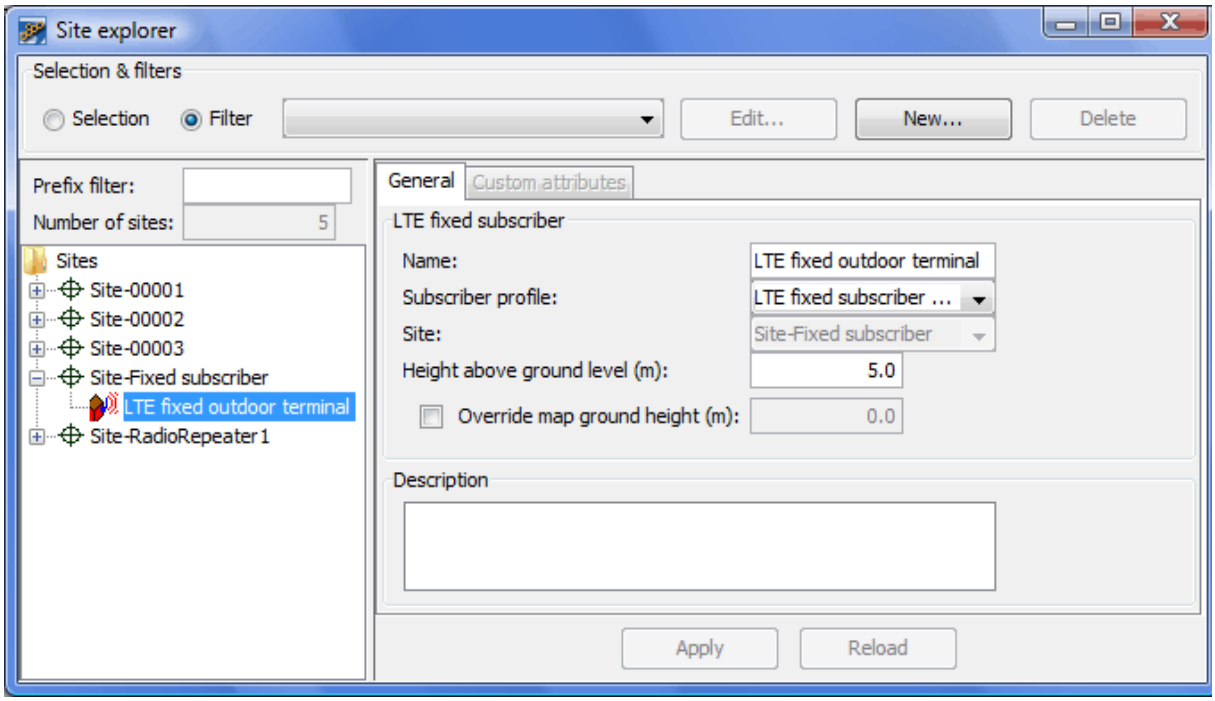
Prerequisites

- The site to host the LTE fixed subscriber is created, see Add Sites.
- The LTE fixed subscriber profile is defined, see Define LTE Fixed Subscriber Profile

Procedure

Follow these steps to add an LTE fixed subscriber to a site:

1. Select **Utilities↗Site explorer.** A list of sites is displayed.
2. Optionally delimit the number of listed sites by a selection or filter.
3. Locate the site in the browser, right-click on the site and select **Add↗LTE fixed subscriber**. The **Select an LTE fixed subscriber profile** window appears.
4. Select the appropriate fixed subscriber profile from the list and click **OK**.
5. The **LTE fixed subscriber** window appears as in the following example:



6. Modify other general parameters of the fixed subscriber site as desired.
7. If you have defined custom attributes for LTE fixed subscribers, you can select flag values for this specific fixed subscriber under the **Custom attributes** tab. See Custom Attributes and Flag Types on page 6-18.

Fields on Window "LTE fixed subscriber"

The fields on the LTE fixed subscriber window are described in the following table:

Field	Description
Name	Name of the LTE fixed subscriber. Maximum 128 alphabetical or numerical characters. Do not use /,\,' or %.
Subscriber profile	Selected fixed subscriber profile, defined in the System explorer.
Site	The site hosting the LTE fixed subscriber. Not editable.
Height above ground level (m)	Overrides the terminals antenna height. Minimum: 1 m. Default = 5 m.

Field	Description
Override map ground height (m)	If enabled, the value to the right of the check box is the explicit ground height, hence the height from the elevation map layer is ignored. Any value is allowed, even negative values. (A zero value means that the fixed subscriber's height position is anyhow retrieved from the elevation map).
Description	Optional description of the fixed subscriber site.

Radio Repeater Sites

Radio repeater sites comprise the following objects:

- One antenna system with
  - One pickup antenna for reception from the donor cell
  - One service antenna relaying amplified signals between donor cell and terminals
  - Optionally one feeder cable
  - Optionally one TMA
- One radio repeater with two antenna branches:
  - One antenna branch with reference to the pickup antenna
  - One antenna branch with reference to the service antenna

You add, modify and delete radio repeater sites with underlying objects from the Site explorer.

For information on how to define radio repeater sites, see the *TEMS CellPlanner Common Features User's Guide*.

Antenna Systems and Antenna Branches

An antenna system is a container object of antenna-related equipment. Each site must have one antenna system defined, as a container of all its antenna-related equipment.

An LTE *antenna branch* defines the antenna type, propagation models, Tx power and optionally cable repeater to use in the cell.

Learn more about these objects in chapter *Antenna Systems and Antenna Branches* in the *TEMS CellPlanner Common Features User's Guide*

Add Antenna System to a Site

An LTE RBS site requires one antenna system with one antenna per sector, normally three antennas (for use with three sectors).

A radio repeater requires one antenna system with two antennas: One pickup antenna and one service antenna.

An LTE fixed subscriber site does not have any antenna system object related to it, although the fixed subscriber is treated as a site due to its fixed position. The antenna parameters are instead defined in the configuration of the terminal type and the fixed subscriber object.

See *Add Antenna System to a Site* in the *TEMS CellPlanner Common Features User's Guide*.

Note: *Do not add any ASC to LTE antenna systems.*
ASCs are selectable, but not used in pure LTE networks.

Add Antenna Branch to an LTE Sector

If you have created an LTE sector using the wizard described in Add Sites, an antenna branch is already created for each sector, provided that an antenna branch template is defined.

The prerequisites and the procedure for adding an antenna branch is the same as for adding an antenna branch template. The difference is that you add the "real" antenna branch from the **Site explorer** or the **LTE RBS explorer**, by selecting the cell, right-click and select **Add antenna branch**.

For details, see Define LTE Antenna Branch Template on page 8-13.

LTE Networks

Currently the **Network explorer**, opened from **Utilities↗Network explorer**, allows you to create LTE SAEs and associate them with LTE RBSs. This user guide however does not provide any more information on SAEs or on the network-level view of an LTE network plan, as future LTE systems are expected to include LTE subnetworks instead of SAEs.

Live LTE networks contain other nodes, such as MMEs and gateways, but as those do not affect the LTE coverage they are not modeled in TEMS CellPlanner.

10 Import and Export of LTE Data

This chapter describes how to import and export LTE specific data and other data used in LTE projects.

Topic **Page**

About Import and Export of LTE Data 10-2
Import and Export of LTE Cell Data 10-2
Import and Export of LTE Neighbor Lists. 10-2
Import and Export of LTE Fixed Subscribers 10-2
Import and Export of Other Data 10-3

About Import and Export of LTE Data

The following LTE specific data can be imported/exported to/from an LTE project:

- LTE cell data
- LTE neighbor lists
- LTE fixed subscribers

You can also import and export generic (non-LTE) data, see Import and Export of Other Data on page 10-3.

Import and Export of LTE Cell Data

LTE cell data can be exchanged with TEMS CellPlanner in two different file formats:

- Cells text file
  Importable and exportable. This file format is used to work on the cell data in spreadsheet or text format outside TEMS CellPlanner.
- TEMS XML cell data file
  Exportable only. You can export cell data from TEMS CellPlanner to XML files and import it into other TEMS tools to reuse cell names and site positions. Compatible TEMS tools and versions are listed in *TEMS Products* in the *TEMS CellPlanner Common Features User's Guide*.

See instructions in *Importing Data* and *Exporting Data* in the *TEMS CellPlanner Common Features User's Guide*.

Import and Export of LTE Neighbor Lists

You can export and import neighbor lists with relations of type LTE-LTE (intra-frequency), LTE-WCDMA and LTE-GSM.

See instructions in *Import Cell Neighbors Text File* and *Export Cell Neighbors Text File* in the *TEMS CellPlanner Common Features User's Guide*.

See also LTE Neighbor Analysis on page 12-29 for information on how to generate and modify neighbor lists in TEMS CellPlanner.

Import and Export of LTE Fixed Subscribers

You can export and import LTE fixed subscribers with their site positions.

See instructions in *Import Fixed Subscribers* and *Export Fixed Subscribers* in the *TEMS CellPlanner Common Features User's Guide*.

See also LTE Fixed Subscriber Sites on page 9-22 for information on how to create, modify, and analyze fixed subscribers in TEMS CellPlanner.

Import and Export of Other Data

In addition to LTE specific data, you can also import/export the following data to/from an LTE project:

- TCP XML, project in XML format for cross-version compatibility

  Tip: Try a demo project delivered in XML format together with this software. See *Use a Demo Project* in the *TEMS CellPlanner Common Features User's Guide*.

- EET/Planet 2.x antennas (import only)
- Generic text file
- Attribute text file
- Generic map file (import only)
- Live traffic text file (import only)

Refer to *Importing Data* and *Exporting Data* in the *TEMS CellPlanner Common Features User's Guide* for more information.

11 Pathloss

Pathloss calculations predict the expected coverage of a network plan, given a certain landscape and propagation model. The predictions are required as input to the LTE Best Server Analysis and further analysis.

Topic **Page**

About Pathloss 11-2
Calculate Pathloss 11-3
Optimized Prediction Radius 11-6

About Pathloss

The pathloss calculation finds the antenna or repeater that gives maximum received power in every bin, either the power received in the bin directly or from the antenna branch of the cell.

The output of calculating pathloss is a prediction containing both the cell's coverage and the coverage of the additional antenna(s).

The pathloss algorithm uses elevation data, the propagation model, the RF correction, antenna gain, land use, and other factors to calculate attenuation to each bin.

If you import or change the Z value for a site (ground level), you must use the same elevation model as the elevation database for predicting pathloss.

The prediction radius defines the maximum operating distance of a selected propagation model. TEMS CellPlanner offers these types of prediction radius:

- At antenna branch level. The radius value is set on individual antenna branch.
- An override during pathloss prediction that is used instead of the value from the antenna branch.
- Optimized by algorithms during calculations.

Pathloss, Predictions, and Fading Margins

When using standard macro cell radio wave propagation models, coverage probability is around 50%. Most operators require coverage probability well above 95%. To consider shadow fading and to increase the coverage probability to reach required target values, an additional margin called the log-normal fading margin is added to the predicted pathloss.

The accuracy of the predicted pathloss depends on verifying the propagation model and tuning it based on drive test measurements.

Propagation Model Tuning and Puncturing

The fading margin applied should be close to the standard deviation of the predicted pathloss. For a standard macro cell propagation model, the standard deviation is in the area of 6 to 14 dB.

For a propagation model tuned towards local radio wave propagation conditions, the standard deviation can become much lower, around 4 to 6 dB. It is generally recommended to perform detailed network planning and LTE analysis based only on tuned propagation models to minimize the error margin in the predicted pathloss.

TEMS CellPlanner provides the feature of puncturing the predicted pathloss with measured pathloss data, thereby increasing the accuracy of the pathloss data that forms a vital input to LTE analysis.

Fading Margins

Using both propagation model tuning and puncturing of pathloss data with drive test measurement data allows network planner to improve accuracy of pathloss data.

Fading margins are applied to increase the coverage confidence mainly for link budget calculations. With a tuned propagation model and detailed map data available to run accurate pathloss predictions, the need for fading margins in the same order as used for link budget calculations decreases.

Calculate Pathloss

Use this procedure to calculate pathloss for an analysis area of selected cells. The output of this calculation is the input to the LTE Best Server Analysis.

Prerequisites

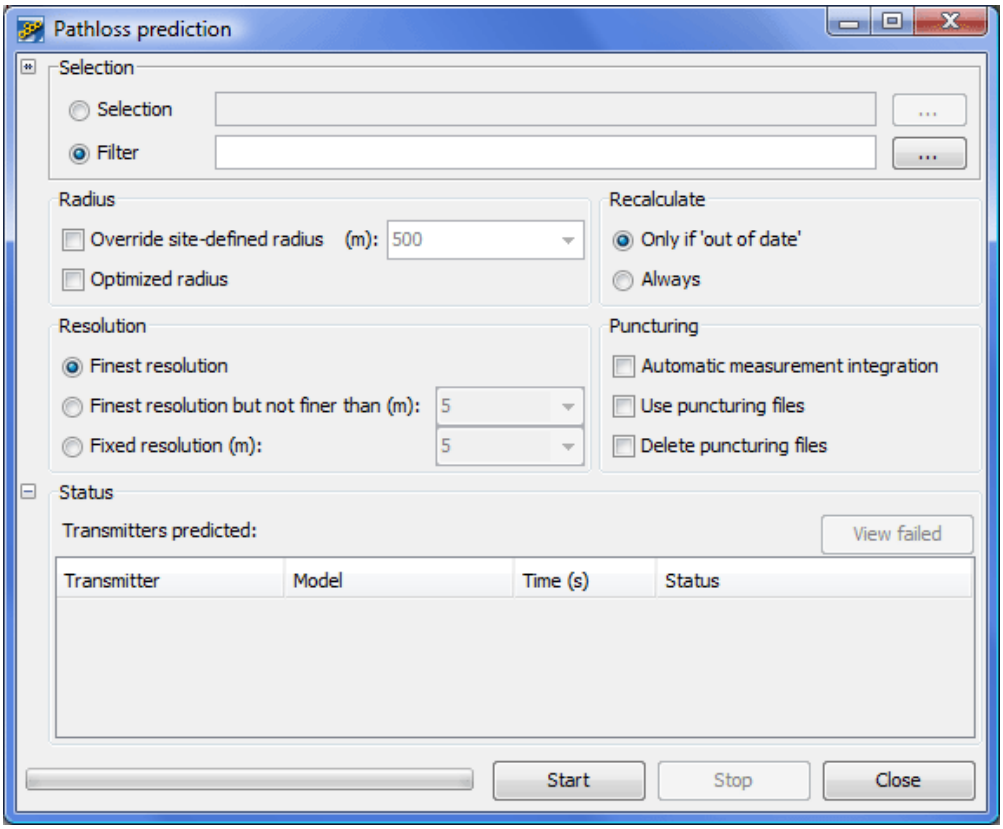
LTE sites with cells are defined, see LTE Sites, RBSs, Sectors, Cells and Networks on page 9-1. The sectors include antenna branches which in their turn include propagation models.

Procedure

Follow these steps to calculate pathloss:

1. Select **Analysis↗Calculate pathloss...**. The Pathloss prediction window appears.
2. Optionally delimit the analysis area by a Selection or Filter.
3. Set the Radius of the analysis area.
4. Set the bin Resolution field to use for the analysis.
5. Set the Recalculate option.

6. Click **Start** to calculate the pathloss. During calculation, the window might look as in the following example:



Fields on Window "Pathloss prediction"

Field	Description
Override site-defined radius	Indicates replacing the site defined radius for the calculation with a specified radius value. Select this option when using the Optimized Prediction Radius. • For initial pathloss prediction, use a larger radius than the actual cell radius to speed up the calculation process. • For pathloss prediction performed before analysis and neighbor list optimization, use the actual radius of the cells to ensure greater accuracy.
Optimized radius	Indicates using an optimized prediction radius for pathloss calculations. See Optimized Prediction Radius on page 11-6 for additional information.
Recalculate	Recalculate options for pathloss prediction: • Only if out of date - Saves calculation time if you made pathloss predictions for some of the cells earlier • **Always** - Makes new calculations for all selected cells

Field	Description
Resolution	The bin size in meters. Determines the resolution of the prediction. In initial pathloss prediction, you can enlarge the bin size to speed up analysis time. • Finest resolution - Uses the finest resolution available in the map data for the selected area of pathloss prediction. • Finest resolution but not finer than (m) - Limits the finest resolution to a specific value for the selected area of pathloss prediction. • Fixed resolution - Uses a fixed resolution specified in meters for the selected area of pathloss prediction.
Puncturing	The puncturing options include: • Use unmasked pathloss data in AMI database to predict pathloss, see chapter *Automatic Measurement Integration* in the *TEMS CellPlanner Common Features User's Guide* • Use available puncturing file when predicting pathloss • Delete puncturing files after pathloss predictions are made
Status	Displays the antenna branches for which the pathloss is predicted. • Transmitter - The antenna branch for which the pathloss is predicted. • Model - The propagation model used for the pathloss prediction. • Time (s) - The time elapsed to calculate the pathloss for the antenna branch. Several calculations may run simultaneously. Therefore, the sum of the time values may be higher than the real time to calculate the pathloss for all branches. • Status

Optimized Prediction Radius

You can run the pathloss calculation in TEMS CellPlanner with an optimized prediction radius. TEMS CellPlanner calculates the optimized prediction radius when the signal strength has become -120 dBm.

Optimized prediction radius is determined in the following way:

- Calculate a maximum theoretical prediction radius based on an antenna's effective radiated power and free space propagation.
- Analyze if line of sight (LOS) exists between the border area of the theoretical free space distance and decreases the prediction radius from free space distance if required.
- Calculate average land use attenuation in the border area of the line of sight/ no line of sight (LOS/NLOS) prediction radius. The prediction radius is decreased from the LOS/NLOS distance if required.
- Use the maximum distance for a useful signal when calculating pathloss for the selected propagation model.

To calculate the optimized prediction radius

- Select Override site-defined radius and enter a long distance, for example, 40,000 m.
- Select Optimized radius, and Calculate Pathloss.

12
LTE Analysis

This chapter describes how to analyze the coverage, interference and traffic performance in an LTE network.

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- Area Selection vs LTE Analysis, Plots and Reports 12-5
- Traffic Demands and Traffic Cases. 12-6

Analyze an LTE Network - Step by Step 12-8

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About LTE Analysis

TEMS CellPlanner offers several analysis functions for your LTE network plan. By using the analysis functions you obtain plots and reports of coverage, interference, traffic performance, and other characteristics.

The analysis results are stored persistently in the calculation results directory when you save the project. This allows you to anytime generate LTE Plots and LTE Reports from the latest analysis results.

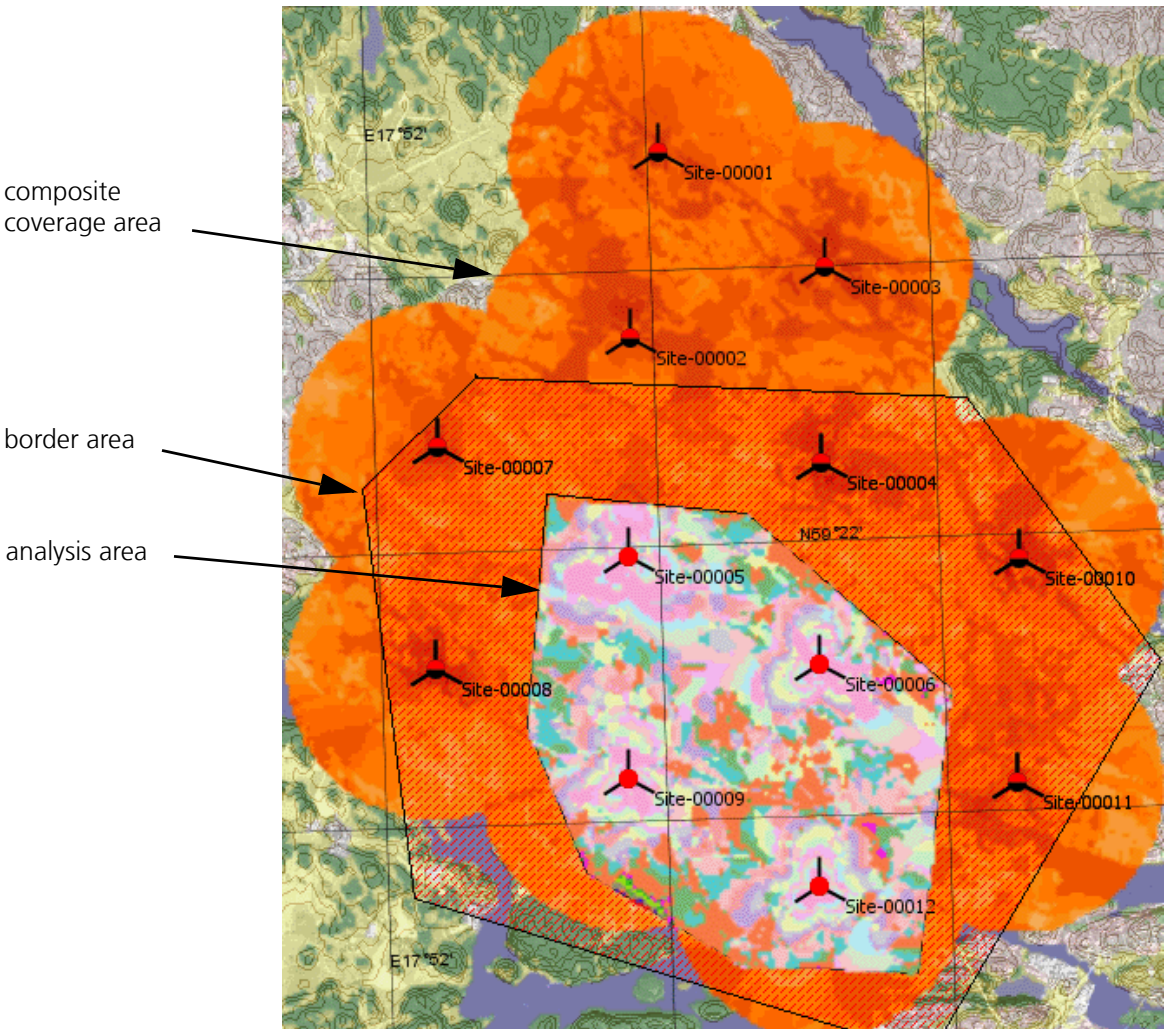
To perform a complete analysis of an existing LTE network plan, take the following steps in the mentioned order:

1. Calculate Pathloss
   This analysis must be performed before best servers can be calculated.
2. Calculate LTE Best Servers.
   This analysis must be performed before the analysis below can be calculated.
3. Analyze LTE Traffic and Interference
4. Generate LTE Neighbor Lists

Analysis Area and Border Area

The analysis considers cells and users in the analysis area and a surrounding border area, while results displayed in plots and reports are limited to the analysis area.

The figure below shows a simple example of an analysis area including four sites with UL C/(I+N) plotted, and a border area including the analysis area plus five surrounding cells. All cells and users within the border area are analyzed:



analysis area

Cells in the *analysis area* are analyzed and presented in plots and reports. The users in the *analysis area* are analyzed and included in plots. Only bins in the analysis area are color coded in plots. The users in the *analysis area* are presented in reports only if served by cells in the analysis area. For details on this topic, see Area Selection vs LTE Analysis, Plots and Reports.

It is mandatory to define an analysis area as a polygon or rectangle map area in the map display. The analysis area has impact on theExecution Time for Monte Carlo Analysis. Refer to *Define Map Area* in the *TEMS CellPlanner Common Features User's Guide* for further instructions.

border area

Cells and users in the *border area* are also analyzed, that is, their traffic load and interference on cells in the analysis area is taken into account in the analysis. If users are served by cells in the analysis area they are also included in reports. For details on this topic, see Area Selection vs LTE Analysis, Plots and Reports.

The default border area is the analysis area, but you may define a polygon or rectangle map area in the map display as a border outside the analysis area. Refer to *Define Map Area* in the *TEMS CellPlanner Common Features User's Guide* for further instructions.

Important: You must manually ensure that the border area embraces the analysis area and includes significant interferers as there is no such check in TEMS CellPlanner. All users creating interference in cells in the analysis area should be included in the border area, even the users not covered by cells in the analysis area.

To ensure that the border area surrounds the entire analysis area, view both areas simultaneously from the LTE analysis wizard Part I: Select Areas for Analysis and move polygon vertices as desired.

Area Selection vs LTE Analysis, Plots and Reports

In the LTE Analysis (Including Interference) you select an analysis area and optionally a wider border area.

Inclusion of cells and users in the analysis area (and possibly also in the border area) determines what is:

- analyzed, that is, the contribution to interference and traffic load is taken into account in the analysis. If you select a border area, the analysis takes into account the cells and users within both the analysis area and border area. If you do not select a border area, the analysis regards the analysis area as border area, and takes into account the cells and users within the analysis area.
- plotted, that is, color coded in LTE Analysis Plots in the map display. Only the bins in the analysis area, covered by cells in the analysis area or border area, are plotted.
- reported with its own row in the LTE Analysis Report. The summary, cell summary and traffic case sub-reports contain only the cells belonging to sites

in the analysis area, but take into account the traffic and interference from cells in the border area (or the analysis area when no border area is selected). The fixed subscriber sub-report contains only the fixed subscribers located in the analysis and border areas, and that are connected to cells located in the analysis area. Fixed subscribers in the border area (or the analysis area when no border area is selected) contributes to the interference and traffic load. Fixed subscribers without serving cell (out of coverage) are excluded from the report.

The table below outlines the exact rules for analyzing, plotting and reporting:

	Analyzed	Plotted	Reported
cells in analysis area	yes	yes	yes
cells in border area	yes	partly *)	-
cells outside analysis/border areas	-	-	-
users in analysis area			
• served by cell in analysis area	yes	-	yes
• served by cell in border area	yes	-	-
users in border area			
• served by cell in analysis area	yes	-	yes
• served by cell in border area	yes	-	-
• served by no cell (out of coverage) *and the device is a fixed subscriber*	yes	-	-
users outside analysis/border areas			
• served by cell in analysis area	-	-	-
• served by cell in border area	-	-	-

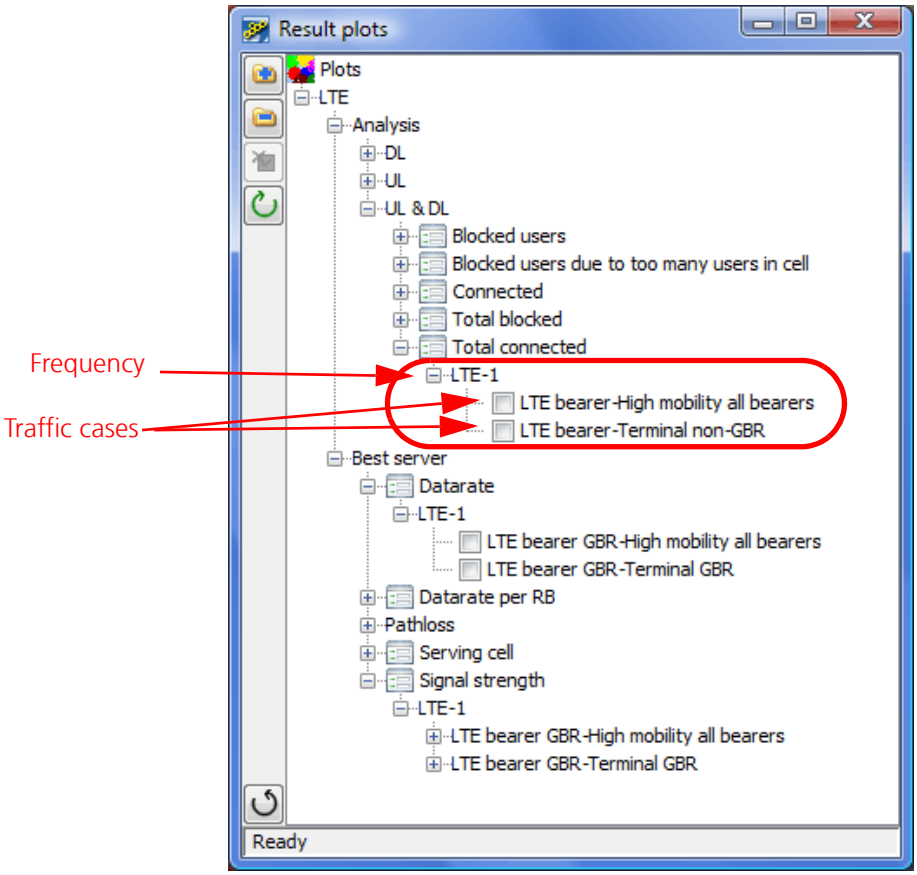
*) Bins in the analysis area covered by cells in the border area are plotted.
*) Bins in the border area are never plotted.

Traffic Demands and Traffic Cases

To analyze the LTE network, you select a *traffic demand mix*, which is a set of traffic demands. A *traffic demand* is defined per bearer, and it models the percentage distribution of terminal types over the analysis area. Terminals are modeled as spread uniformly or according to a land use specific *traffic density map*.

Some analysis is carried out per *traffic case*, which models **one terminal** using **one bearer**. All traffic cases retrieved from the traffic demand mix are analyzed and the

results are preserved. You can view the coverage and performance per traffic case as plots, selected from the Results plots window exemplified below:



Refer to Traffic Demand Mixes on page 6-18 for more information on this topic.

Analyze an LTE Network - Step by Step

Do as follows to analyze an LTE network:

❶ Create an LTE project with network objects and mobile LTE devices:

- Create an LTE Project
- Create LTE Network System Data
- Create LTE Network Radio Equipment Types
- Create LTE RBS Sites
- Create LTE Terminal Types for at least one mobile LTE device
- Create Traffic Demand Mixes, at least one

❷ Shall fixed LTE devices be included in the analysis? Then add fixed subscribers:

- Create LTE Terminal Types for at least one fixed LTE device
- Create one ore more LTE Fixed Subscriber Profiles using a fixed terminal type
- Create fixed subscribers either by importing (see Import and Export of LTE Neighbor Lists) or by creating LTE Fixed Subscriber Sites
- Select point-to-point propagation model for the LTE RBSs, see Add Antenna Branch to an LTE Sector

❸ Analyze pathloss and best servers:

- Calculate Pathloss
- Calculate LTE Best Servers for one traffic demand mix
- Check LTE Best Server Plots

❹ Create an analysis area and an optional border area for a deeper analysis including traffic load and interference:

- See Analysis Area and Border Area

❺ Set simulation parameters in the LTE analysis wizard:

- Part I: Select Areas for Analysis
- Part II: Configure Monte Carlo Simulator
- Part III: Configure System Parameters
- Part IV: Select Traffic from the traffic demand mix
- Shall fixed LTE devices be included in the analysis? Then select the option in Part IV: Select Traffic to **Include** fixed subscribers in the analysis.

❻ Start the analysis from the LTE analysis wizard:

- Part V: Run Monte Carlo Analysis

❼ Check analysis results:

- Check LTE Plots in the map window
- Check LTE Reports

LTE Best Server Analysis

The purpose of the LTE best server analysis is to find the best serving cells in an LTE project and provide plots displaying the best servers per bin.

No interference from surrounding cells or terminals is taken into account.

The best server analysis first calculates the composite pathloss for every bin, and then evaluates the best servers for all traffic cases of the selected traffic demand mix. For every bin, the cell with the strongest received signal is the best server.

The analysis is limited to calculate the coverage of one carrier frequency. The DL interference is modeled by means of the average transmitted power from each cell, where different cells in reality may transmit on different parts of the carrier. The effect of the possible switching on and off of the DL transmission over the whole carrier or over parts of it is not considered in the best server analysis, but in the more refined LTE Analysis (Including Interference).

The results can be viewed as LTE Best Server Plots, showing the best server anywhere in the network.

Composite Pathloss and CPLM

The best server analysis calculates the composite pathloss for every bin. The results are stored in a composite path loss matrix (CPLM) reused by other LTE analysis functions. The CPLM contains, for every bin, an ordered list of cells together with their predicted pathloss to the bin.

The composite pathloss prediction is actually performed per Tx antenna branch. The antenna branches considered in CPLM are the ordinary sector antenna branches, sector antenna branches defined as cable repeaters, and radio repeater antenna branches including a service antenna.

Cells with antennas at slightly separated positions are also considered, for example cells with cable repeaters and MIMO antennas.

The following criteria must be met for cells to be considered in the composite pathloss calculation:

- The pathloss of the cell transmitting on the selected carrier frequency to the bin must have been predicted and be lower than a configured limit.
- The number of cells covering the bin must not exceed a configured limit. If more cells cover the bin, only the cells with the lowest pathloss are considered.

Calculate LTE Best Servers

Use this procedure to find the best serving cells in an LTE network and to produce a CPLM for other analysis functions.

Prerequisites

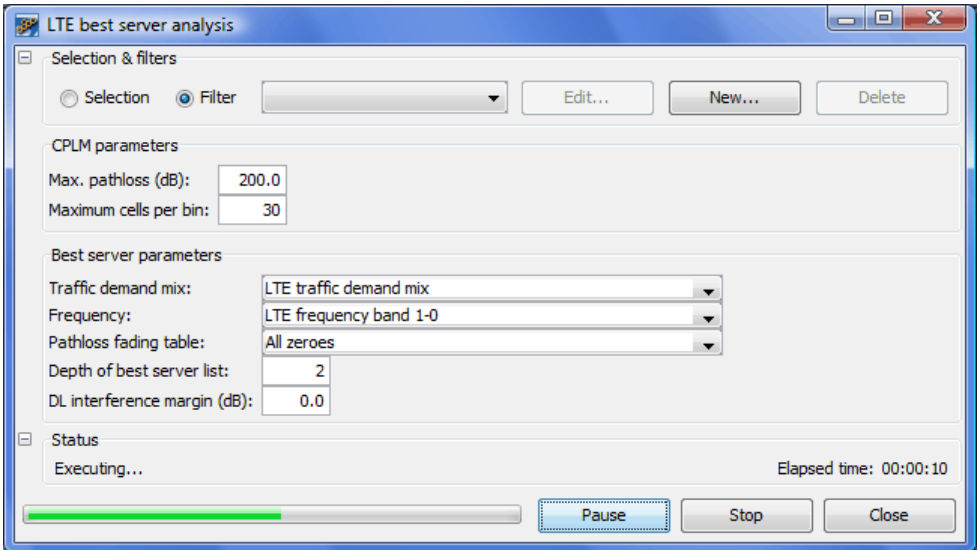
The following is required before calculating best servers:

- LTE RBS Sites with sectors, cells and antenna branches are defined
- Optional: Radio Repeater Sites with antenna branches are defined
- Select LTE Carrier Channels to define a carrier to analyze
- At least one traffic demand mix with at least one traffic case is defined, see Traffic Demands and Traffic Cases
- Results from Pathloss predictions are available

Procedure

Follow these steps to calculate the best serving cells in your LTE project:

1. Select **Analysis↗LTE↗Calculate best server...** The **LTE best server analysis** window is displayed.
2. Optionally delimit the number of analyzed cells by a **Selection** or **Filter**.
3. Select the **Traffic demand mix** to analyze.
4. Select the carrier **Frequency** to analyze.
5. Select a **Pathloss fading table**.
6. Update the other parameters as required.
7. Click **Start** to begin the calculation. The status bar indicates the progress, as in the following example:



8. When the calculation is completed you can view the results as plots, see LTE Best Server Plots on page 13-4.

Fields on Window "LTE best server analysis"

Field	Description
Selection	Limitation of number of analyzed cells, see *Using Filters* in the *TEMS CellPlanner Common Features User's Guide*.
CPLM parameters - see Composite Pathloss and CPLM on page 12-9	
Max. pathloss (dB)	Maximum pathloss to consider in the composite pathloss calculation of one bin. Cells exceeding this limit are excluded from the CPLM. Range: 10 - 200. Default = 200 dB.
Maximum cells per bin	Maximum number of cells from which composite pathloss values are calculated in one bin. If the number of cells covering the bin exceeds this limit, the cells with the highest pathloss are excluded from the CPLM. Range: 1 - 30. Default = 30.
Best server parameters	
Traffic demand mix	Selected mix of terminal types and their respective contribution to the load in the network, see Traffic Demands and Traffic Cases on page 12-6.
Frequency	Selected carrier frequency to analyze. Only cells using this frequency band and carrier are considered in the analysis. Syntax: `<frequency band>-<EARFCN number>.`
Pathloss fading table	A list of available pathloss fading tables, with fading per land use code. See *Pathloss Fading Tables* in the *TEMS CellPlanner Common Features User's Guide*.
Depth of best server list	Determines the number of plots to generate, which for every bin on the map shows the identity or signal strength of the first, second, and third ranked cell that may serve a terminal located in the bin. Range = 1 - 30. Default = 2.
DL interference margin (dB)	Estimated DL interference in the network. The DL signal strength is reduced by this value when mapping C/(I+N) to bitrate. Range: 0 - 30. Default = 0 dB
Start/Pause, Stop, Close, Status, Next, Previous	

LTE Analysis (Including Interference)

Read Quick Introduction to LTE Analysis (Including Interference) on page 12-12 or proceed directly with Analyze LTE Traffic and Interference on page 12-15.

Terminology in Plots and Reports

user	UE (mobile or stationary) or fixed subscriber with a terminal device
connected users	users successfully connected to some cell in a trial
not connected users	see blocked users
blocked users	users failed to connect to any cell in a trial, blocked by the scheduler, for example due to overload, too many users, GBR not reached, insufficient capacity, or rejected on resource shortage
served users	see connected users
bit rate	see data rate
data rate	PDSCH or PUSCH traffic data only, signalling overhead is not included
served data rate	In plots and in per traffic case reports (not the summary report), served data rate is the data rate per cell summed over all connected and not connected terminals in the cell. In the summary report, served data rate is the average data rate over all served users. If the served rate equals the (requested) average bit rate of the bearer, then all connected users have got their requested rate. If some users are connected at a lower rate than the requested, this will appear as a lower served rate. The rate that could not be served is instead included in the non-served data rate. In the fixed subscriber report, served data rate is the average data rate over all time the fixed subscriber is connected.
non-served users	see blocked users
non-served data rate	an average over all users, both connected and blocked ones. The non-served rate includes all of the requested rate of the blocked users, and the denied part (if any) of the requested rate for the connected users.

Quick Introduction to LTE Analysis (Including Interference)

For a detailed description of LTE analysis, refer to the *TEMS CellPlanner LTE Technical Reference Manual*.

The purpose of the LTE Analysis (Including Interference) is to calculate uplink and downlink interference and traffic performance taking into account the load from

surrounding users and cells. The analysis is performed by algorithms in a Monte Carlo Simulator. The results are stored persistently and can anytime be viewed as LTE Analysis Plots or as an LTE Analysis Report.

The analysis calculates the characteristics of one carrier frequency at a time.

Monte Carlo Simulator

TEMS CellPlanner has implemented a so called Monte Carlo simulator to model LTE networks with load. The same technique is used to analyze WCDMA networks.

The Monte Carlo technique is especially suitable to calculate interference in RF environments with users located close to cell borders, where they can cause considerable uplink interference in neighboring cells.

The Monte Carlo simulator randomly distributes mobile UEs over the analysis area and performs calculations in a number of trials (default 10) using a random UE distribution in each trial. The simulation of uplink scheduling includes admission control with QoS parameters like Guaranteed Bit Rate (GBR). The scheduler in a cell randomly assigns RBs to connected users, with at most one active (transmitting) UE per time frame in every cell.

The interference affects the achieved bit rate, and might also have impact on the required UE power and the amount of traffic that can be scheduled in a cell. This will in its turn affect the interference in other cells. Within each random trial, the Monte Carlo simulator iterates the calculations to achieve convergence that is, a stable result.

Random Interference Modeling

TEMS CellPlanner models random interference. Each interfering user is assumed to either constantly send uplink traffic data with optimal power, or not interfere at all, according to a probability spread over the number of trials. The uplink Activity Factor (AF) of the interfering user defines the interference probability. The algorithm makes a new decision about the activity (on or off) every time the achieved bit rate is changed, since the AF will then get a new value. Each trial results in an interference value, and the final result is the average interference from all trials.

Activity Factor (AF)

The "activity factor" AF is calculated per user as the requested bit rate divided by the achieved bit rate for that number of RBs. A user has an AF < 1 if its requested average bit rate is lower than the achieved bit rate, with optimal number of RBs using the optimal power level.

Execution Time for Monte Carlo Analysis

The analysis execution time depends on the following in mentioned order:

- number of cells, users and bins in the analysis area (highest impact)

- number of trials in the Monte Carlo settings
- number of cells and users in the border area
- convergence limit, affecting the number of iterations needed

The number of trials also affects the time required for plot generation (done as a last step of the analysis) of plots with values calculated per bin, namely:

- signal quality (SINR), plotted as DL C/(I+N) and UL C/(I+N)
- power margin, plotted as UL Power Margin
- data rate per bin, plotted as (Instantaneous) DL Data Rate (with Interference) and (Instantaneous) UL Data Rate (with Interference)

Analyze LTE Traffic and Interference

The LTE analysis wizard takes you through the following flow to analyze the LTE characteristics in uplink and downlink:

- Part I: Select Areas for Analysis
- Part II: Configure Monte Carlo Simulator
- Part III: Configure System Parameters
- Part IV: Select Traffic
- Part V: Run Monte Carlo Analysis
- Part VI: Generate Report

Part I: Select Areas for Analysis

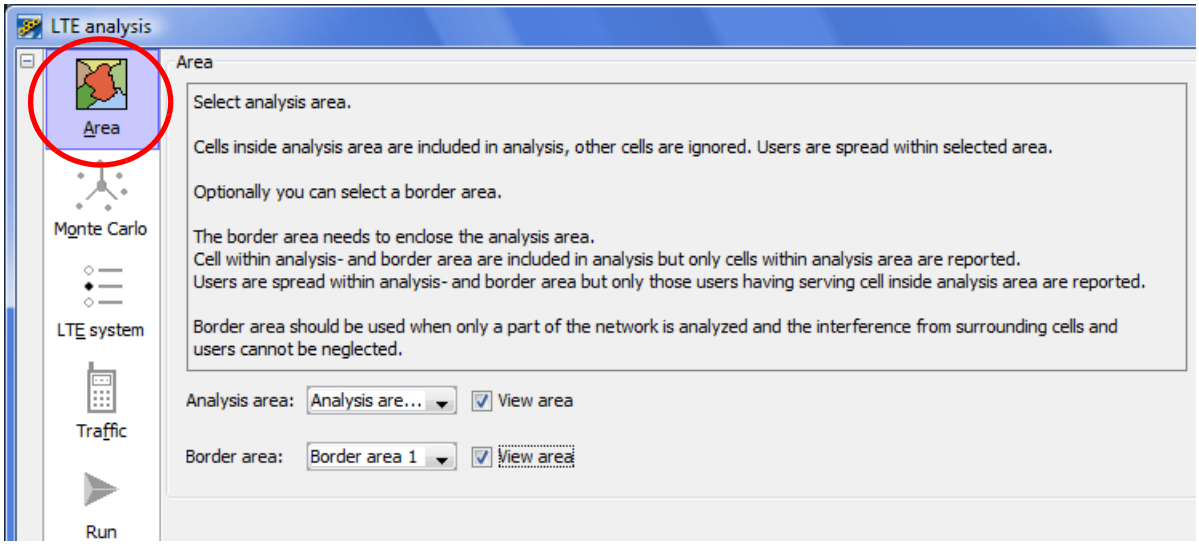
Use this procedure to define the Analysis Area and Border Area.

Prerequisites

To limit the plot area (the area for which cells and UEs are plotted and reported) you must define an analysis area You may also define a wider border area to include load and interference from other close interferers in the analysis. See *Define Map Area* in the *TEMS CellPlanner Common Features User's Guide*.

Procedure

1. Select **Analysis↗LTE↗Analyze LTE...** The **LTE analysis** window appears.
2. Select the **Area** icon to open the Area page as in the following example:



3. Select an analysis area and a border area to limit the cells and subscribers included in the analysis, plots and reports. Make your selection from the map areas in the list to the right of each area parameter.

   The time to perform the analysis increases with the number of cells and subscribers to analyze.

4. Click **Next** to proceed to Part II: Configure Monte Carlo Simulator.

Fields on Window "LTE analysis - Area"

Field	Description
Analysis area	Limits the number of cells and subscribers included in analysis, plots and reports. See also: • Analysis Area and Border Area on page 12-4 • Area Selection vs LTE Analysis, Plots and Reports on page 12-5
Border area	
View area	Enabling this option displays the map area selected as analysis or border area in the map display. The areas remain displayed as long as you keep the **LTE analysis** window open.
Start/Pause, Stop, Close, Status, Next, Previous	

Part II: Configure Monte Carlo Simulator

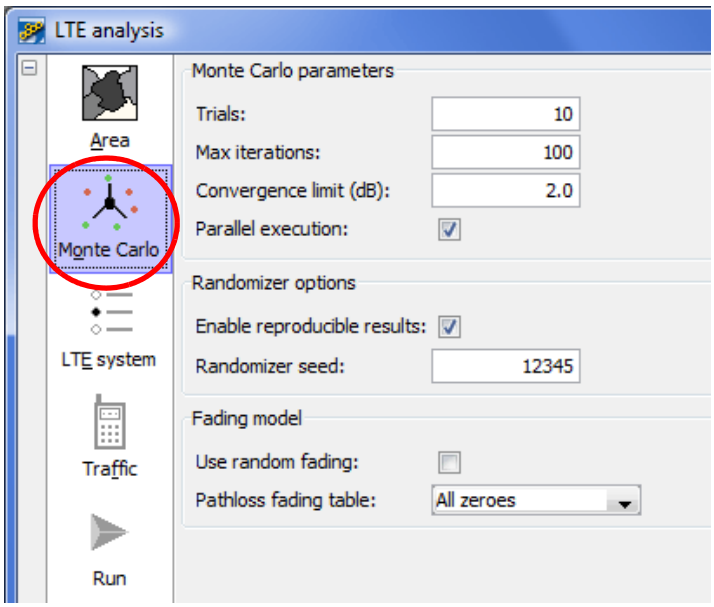
Use this procedure to select pathloss fading table and non-default Monte Carlo parameter values for the LTE Analysis (Including Interference).

Prerequisites

At least one pathloss fading table shall be defined, see Pathloss Fading Tables on page 6-18.

Procedure

1. Select **Analysis↗LTE↗Analyze LTE...** The **LTE analysis** window appears.
2. Select the **Monte Carlo** icon to open the Monte Carlo parameters page as in the following example:



3. Set the parameters as required, see Fields on Window "LTE analysis - Monte Carlo parameters" on page 12-18.
4. Click **Next** to proceed to Part III: Configure System Parameters.

Fields on Window "LTE analysis - Monte Carlo parameters"

Field	Description
Monte Carlo parameters	
Trials	The number of times to run the analysis with different UE distribution. The larger the number, the higher the statistical confidence, and the longer the execution time. Start with 10 trials, and for higher accuracy increase the number of trials. It is recommended to run between 20 and 100 trials at the final stage of the network planning process. Range: 1 - 100. Initial value = 10.
Max iterations	Maximum number of times to repeat a trial if convergence is not yet reached. During an iteration, the power settings are slightly changed to approach stability, where the power setting and interference arrive at a steady state at the end of a trial. This steady state is called convergence. For the most simple convergence criteria of uplink noise rise, approximately 5 iterations are sufficient. If the maximum number of iterations is set too low, the trial fails and its results are discarded. You should then increase the maximum number of iterations. Range: 1 - 10000. Initial value = 100.
Convergence limit (dB)	Max delta from cell UL noise rise between two consecutive iterations. A low convergence limit gives higher confidence but requires more iterations per trial. Range: 0.01 - 15. Initial value = 2.0 dB.
Parallel execution	Relevant only on multi-processor computers. Allows parallel execution of trials when number of available processors are more than one. Decreases execution time but requires more heap memory. Should be disabled if the amount of memory is low. Default = Enabled.
Randomizer options	
Enable reproducible results	UEs (users) are spread according to a random pattern. With this option selected, the random number generator always starts from the same value (seed). This leads to reuse of the subscriber distribution, and giving the same analysis results, as in previous trial. Default = Enabled.
Randomizer seed	Seed value for the random number generator that controls the distribution of users in the network. Enabled if option **Enable reproducible results** selected. Initial value = 12345
Fading model	
Use random fading	Enables use of random fading on every individual radio link between users and cells. Simulates fast fading. Default = Disabled.
Pathloss fading table	Use landuse dependent log-normal fading margins, applied per bin. The mapping of landuse code to fading margin is selected from a list of Pathloss Fading Tables. If **Use random fading** is selected, the values per landuse code in column **Standard deviation** are still used to generate the random fading.
Start/Pause, Stop, Close, Status, Next, Previous	

Part III: Configure System Parameters

Use this procedure to select frequency, UL and DL scheduling, and admission and power control settings for the LTE Analysis (Including Interference).

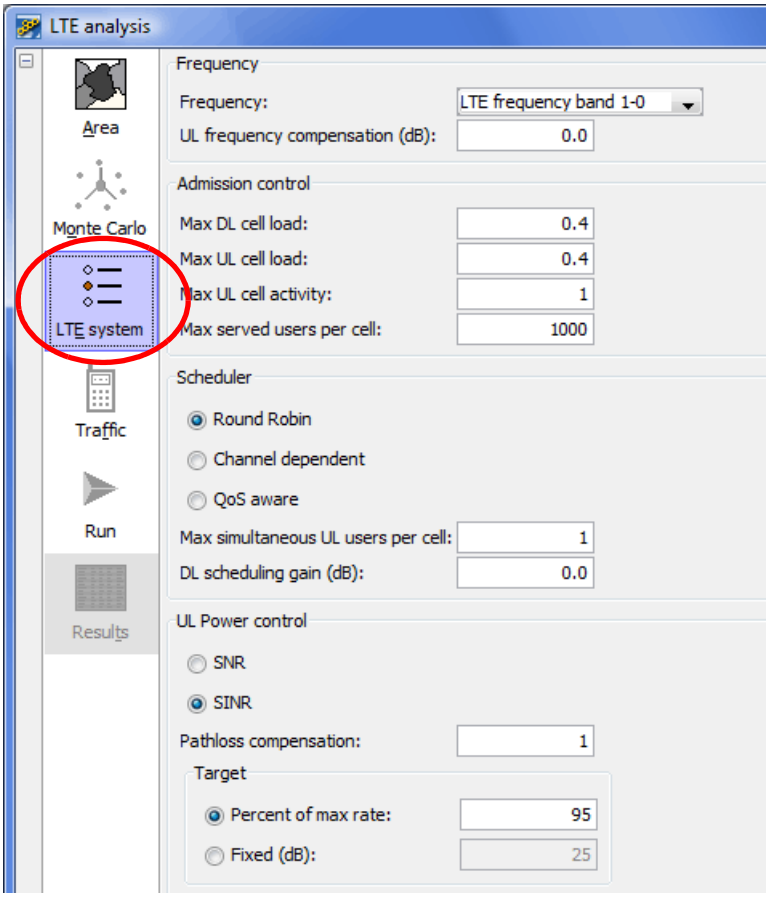
The UL and DL scheduling is capable of Time Spread Allocation (TSA), bit rate shaping, and prioritizing of guaranteed bit rate (GBR) users before non-GBR users. Read more on these topics in the *TEMS CellPlanner LTE Technical Reference Manual*.

Prerequisites

The carrier frequency (DL EARFCN) to analyze must be defined, see Select LTE Carrier Channels on page 6-10.

Procedure

1. Select **Analysis↗LTE↗Analyze LTE...** The **LTE analysis** window appears.
2. Select the **LTE system** icon to open the system parameters page as in the following example:



3. Select the frequency.

4. Set the other parameters as required, see Fields on Window "LTE analysis - System parameters" on page 12-20.
5. Click **Next** to proceed to Part IV: Select Traffic.

Fields on Window "LTE analysis - System parameters"

Field	Description
Frequency	
Frequency	Selected carrier frequency to analyze. Only cells using this frequency band and carrier are considered in the analysis. Syntax: `<frequency band>-<EARFCN number>`.
UL frequency compensation (dB)	The pathloss will be reduced by this factor to compensate for the pathloss difference between DL and UL frequencies. You assign an appropriate value depending on the analyzed environment. The formula below might be used for a mixed environment (various heights, various landuse categories): $\text{factor} = 24 \times \log\langle\frac{f2}{f1}\rangle$ where • f1 = lower (UL) frequency • f2 = upper (DL) frequency Range: 0 - 3. Initial value = 0 dB.
Admission control	
Max DL cell load	Upper load limit for the DL scheduling of resources. The traffic dependent DL load may be lower than or equal to this limit. Range: 0 - 1. Initial value = 0.4 (40%).
Max UL cell load	Upper load limit for the UL scheduling of resources. The traffic dependent UL load may be lower than or equal to this limit. Range: 0 - 1. Initial value = 0.4 (40%).
Max UL cell activity	Useful parameter when evaluating different loading scenarios. Upper limit for the uplink Activity Factor (AF). Limits the cell load by limiting the percentage of time the cell is active in uplink, that is, receiving. The parameter is used for all cells. The actual load on the cell depends on the selected traffic demand mix, but will never exceed this value. Range: 0 - 1. Initial value = 1 (100%). ***Note:*** *High UL cell activity requires high* ***Time fraction used for UL traffic*** *in the* LTE Carrier Mappings.
Max served users per cell	The upper limit on the number of scheduled users per cell, set by the signaling resources. Range: 1 - 1000. Initial value = 1000.
Scheduler	
(Scheduling method)	Queueing criteria for data to be transmitted. Select one of: • **Round Robin** - Users are served by rotation (default) • **Channel dependent** - Users with good radio conditions are favored • **QoS aware** - GBR users are served first, then non-GBR. Users within these groups are sorted in priority order.

Field	Description
Max simultaneous UL users per cell	The maximum number of users being scheduled for each time frame. Range: 1 - 10. Initial value = 1. A value higher than 1 shall be entered only when simulating a network supporting TSA.
DL scheduling gain (dB)	The SINR improvement achieved by the scheduler. Affects the DL cell load only. Range: 0 - 30. Initial value = 0 dB.
Power control	
UL power control	Open-loop power control, defining what each connected UE compensates for: • **SNR** - UE compensates for receiver noise only • **SINR** - (default) UE compensates for receiver noise and interference
Pathloss compensation	"Alpha" factor used for pathloss compensation, attenuating the terminals close to cell borders, in order to decrease the interference from those terminals. Range: 0 - 1. Initial value = 1 (full compensation). A value lower than 1 indicates partial compensation.
Target	The power control target for connected UEs. The target is either a fix value in dB or set in relation to the data rate. Select either of: • **Percent of max rate** - (default) target in relation to SNR/SINR. The target power will give this percentage of maximum possible bitrate for every UL connection. Range: 0 - 100. Initial value: 95%. • **Fixed (dB)** - the SNR/SINR ratio defines the fixed power control target for all service types. The target power will give this SIR or SINR for every UL connection. Range: 0 40. Initial value: 25 dB. ***Note:*** *Some networks and traffic scenarios can be very sensitive to the power control target. For example, setting a very high target can actually degrade the overall network performance.*
Start/Pause, Stop, Close, Status, Next, Previous	

Part IV: Select Traffic

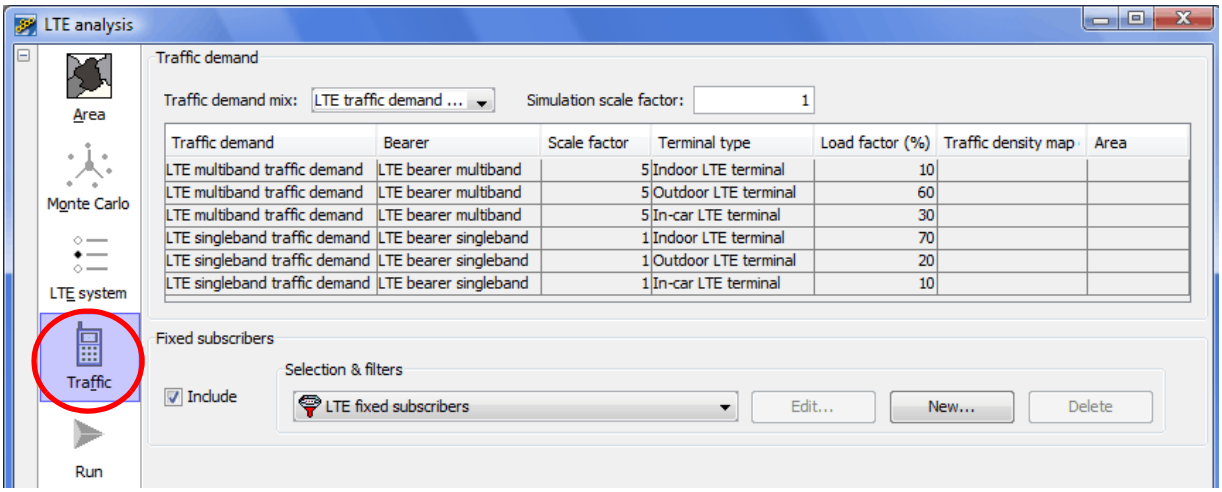
Use this procedure to select the traffic demand mix for the LTE Analysis (Including Interference), and to adjust the traffic load.

Prerequisites

The traffic demand mix to analyze is defined, see Traffic Demands and Traffic Cases on page 12-6.

Procedure

1. Select **Analysis↗LTE↗Analyze LTE...** The **LTE analysis** window appears.
2. Select the **Traffic** icon to display the Traffic demand page as below:



3. Select **Traffic demand mix**.
4. Select **Simulation scale factor**.
5. If fixed LTE devices shall be included in the analysis, click **Include** and optionally use a filter to select the fixed subscribers.

Proceed to Part V: Run Monte Carlo Analysis.

Fields on Window “LTE analysis - Traffic”

Field	Description
Traffic demand mix	The mix of traffic demands used to simulate traffic load. Selected from list of user-defined traffic demand mixes, see Traffic Demands and Traffic Cases on page 12-6.
Simulation scale factor	Trimming factor used to increase or decrease the traffic load. Scales all traffic demands in the selected **Traffic demand mix**. Range: 0 - 1000. Initial value: 1 (no scaling). Examples: Set a value < 1 to get a lower load than in the traffic demand mix. Set value 2 to double the load.
(Read-only list of traffic demands from the traffic demand mix)	The following is displayed per traffic demand: • Traffic demand name • Bearer • Scale factor • Terminal • Load factor (%) • Traffic density map • Area (non-empty if the traffic demand is area-based)
Fixed subscribers	Select option **Include** to consider traffic and interference of fixed LTE subscribers in the analysis. Optionally use a filter to reduce the number of fixed subscribers included.
Start/Pause, Stop, Close, Status, Next, Previous	

Part V: Run Monte Carlo Analysis

Use this procedure to run the Monte Carlo analysis, resulting in plots and report data for the traffic and interference situation in uplink and downlink.

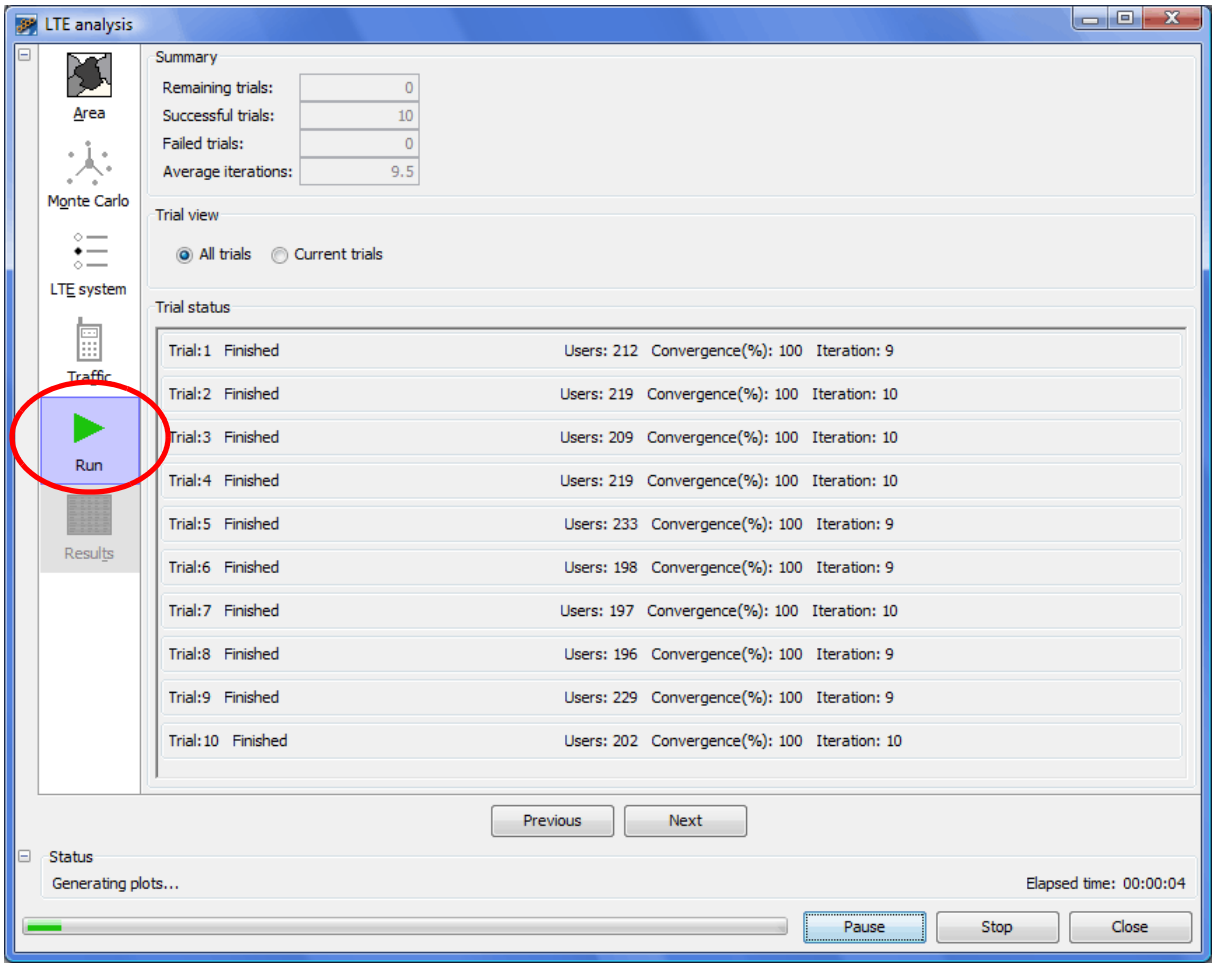
Prerequisites

- Results (pathloss predictions, CPLM) from LTE Best Server Analysis are available
- LTE sites with cells are defined, see Add Sites and Add LTE Cell
- The Suggested LTE Terminal Typess to use are defined
- The analysis and border areas are selected in Part I: Select Areas for Analysis
- The Monte Carlo parameters, including carrier frequency and pathloss fading table, are assigned in Part II: Configure Monte Carlo Simulator
- A traffic demand mix is selected in Part IV: Select Traffic
- A frequency is selected in Part III: Configure System Parameters
- If fixed LTE devices shall be included in the analysis, the following is required:
- LTE Fixed Subscriber Sites are defined
- Each LTE RBS sector has a PtP (point-to-point) propagation model assigned to its antenna branch, see Add Antenna Branch to an LTE Sector

Procedure

1. Select **Analysis↗LTE↗Analyze LTE...** The **LTE analysis** window appears.
2. Select the **Run** icon. The Summary page is displayed.
3. Set the **Trial view** parameters as desired.

4. Click **Start**. The analysis starts and the progress is displayed in the **Status**, the **Trial status**, and the **Summary** fields, as in the following example:



5. The calculated DL and UL utilization overwrites the cell specific DL and UL load configured in Configure LTE Cell Analysis Parameters.

6. The wizard automatically proceeds to Part VI: Generate Report when the analysis completes.

Fields on Window "LTE analysis - Results"

Field	Description
Summary	• **Remaining trials** - number of trials left before completion • **Successful trials** - executed trials meeting the convergence criteria • **Failed trials** - executed trials not meeting the convergence criteria • **Average iterations** - ...needed for successful trials
Trial view	• **All trials** - displays the status of each trial • Current trials - for each trial, displays the status of ongoing trial

Field	Description
Trial status	Snapshot of ongoing execution. • **Status** - intermediate status followed by final status Finished (successfully) or Failed • **Users** - number of users considered in the trial • **Convergence** - percentage of cells currently meeting the convergence criteria • **Iteration** - current number of executed iterations
Start/Pause, Stop, Close, Status, Next, Previous	

Part VI: Generate Report

After Part V: Run Monte Carlo Analysis the Results window is opened, showing the date and time of the latest results.

Use this procedure to generate an LTE Analysis Report including uplink interference, utilization, noise rise, bit rate of served/not served users, and the number of connected/blocked users. You select whether to include mean values only, or all of mean/minimum/maximum/standard deviation values.

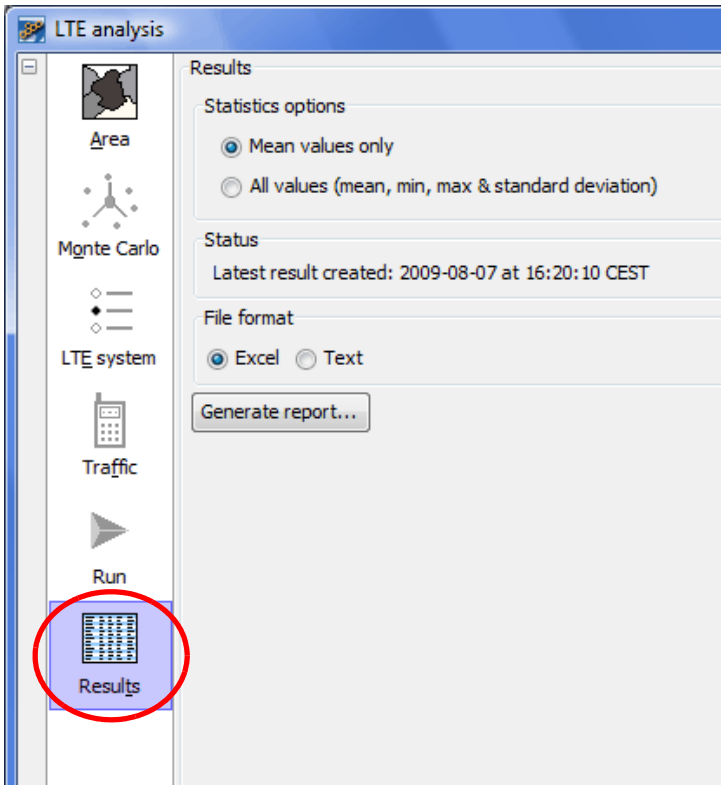
At this stage you can also generate LTE Analysis Plots, and from the plots compare results, as described in *Screen Statistics of Plots* in the *TEMS CellPlanner Common Features User's Guide*.

Prerequisites

Uplink and downlink analysis results are available from successful execution as described in Part V: Run Monte Carlo Analysis.

Procedure

1. Select **Analysis↗LTE↗Analyze LTE...** The **LTE analysis** window appears.
2. Select the **Results** icon to open the Results page as in the example below:



3. Select the appropriate statistics option: **Mean values only** or **All values**.
4. Select report **File format** Excel or Text.
5. Click **Generate Report**. The time required to create the report depends on the number of reported cells and UEs. Format and contents are described in LTE Analysis Report on page 14-2.
6. Save the file.

See also LTE Analysis Plots on page 13-12.

Fields on Window "LTE UL analysis - Results"

Field	Description
Statistics options	• Mean values only • All values (mean, min, max & standard deviation)
Status	Date and time of latest result
File format	• Excel - one file with at least three tabs • Text - at least three files with tab-separated fields See Format of LTE Analysis Reports on page 14-3.
Generate report	Creates an LTE Analysis Report of selected **File format**, including the analysis results according to selected **Statistics options**.
Start/Pause, Stop, Close, Status, Next, Previous	

Common Buttons and Fields in Analysis Windows

Start/Pause, Stop, Close, Status, Next, Previous

The following fields are common to most LTE analysis windows:

Field	Description
Start	Initiates the analysis
Pause	Temporarily inhibits the analysis
Stop	Stops an ongoing analysis
Close	Stops any ongoing analysis and closes the window
Status	Displays progress in text and on progress bar
Next	Opens the next page without stopping any ongoing analysis. Included in wizard pages only.
Previous	Opens previous page without stopping any ongoing analysis. Included in wizard pages only.

LTE Neighbor Analysis

Chapter Neighbors in the *TEMS CellPlanner Common Features User's Guide* contains a more up-to-date description on how you can add, modify and delete neighbors. The descriptions below will be aligned in a later release.

You can create two types of neighbor lists with TEMS CellPlanner:

Generated neighbor lists	Automatically generated neighbor relations. Cells are included in the neighbor list of another cell if handover is possible.
Cell neighbor lists	Manually created neighbors in the cell configuration. Neighbors are selected from a tree structure in the LTE RBS explorer or Site explorer.

Neighbor information is not used for the LTE Analysis, but you can export neighbor information and later import it for use in Cell ID Planning.

Note: *Export/import of blacklist information is not yet supported.*

Changes in the automatically generated neighbor list may be applied to the manually created cell neighbor list, and vice versa.

This section describes the *generated neighbor lists*. For information on *cell neighbor lists in cell data*, see Select Neighbor Cells on page 9-17.

About Generated Neighbor Lists

The purpose of the LTE neighbor analysis is to automatically generate neighbor lists for a selected traffic case. The LTE neighbor lists can be of the following types:

- LTE/LTE intra-frequency relations
- LTE/GSM inter-frequency relations
- LTE/WCDMA inter-frequency relations

The neighbor analysis evaluates, for each cell and selected traffic case, possible neighbor cells using the specified carrier. Neighbor cells are the cells to/from which handover is possible from/to the analyzed cell. For each analyzed cell, the analysis presents the neighbor cells in a *neighbor list*. You accept the contents of the neighbor list by applying the list.

This automatic neighbor generation is the quickest and most reliable method to setup neighbor lists. Only relations allowing handover are included in the generated neighbor lists. If you rely on the analysis to generate the neighbor lists for you, no user interaction is needed after having generated the lists.

You may override the automatic selection by moving cells between the *neighbor list* and a *waiting list* (still possible candidates), an *error list* (rejected candidates), a *blocked list* for distant or blacklisted (unallowed) cells, and a list with *all other cells*.

You can also export the generated neighbor lists from a button in the analysis window to a text file. Note that you cannot use the ordinary export and import menus (File↗Export, File↗Import) to export or import generated neighbor lists, as another file format is used for the other type of neighbor lists. Note also that information about blacklisted cells can not yet be exported or imported.

Generate LTE Neighbor Lists

Use this procedure to automatically generate lists of LTE, WCDMA or GSM cells neighboring the LTE cells in your network plan.

Prerequisites

- The traffic demand mix to analyze is defined, see chapter *Traffic Demands* in the *TEMS CellPlanner Common Features User's Guide*. You select a traffic case from the traffic demand mix.
- LTE Best Server Analysis for the LTE carrier to analyze has been successfully run
- To generate WCDMA neighbors: **Analysis↗WCDMA↗Calculate composite pathloss** for the WCDMA carrier has been successfully run
- To generate GSM neighbors: **Analysis↗GSM↗Calculate best server** for the GSM carrier has been successfully run

Procedure

Do as follows to generate LTE neighbor lists:

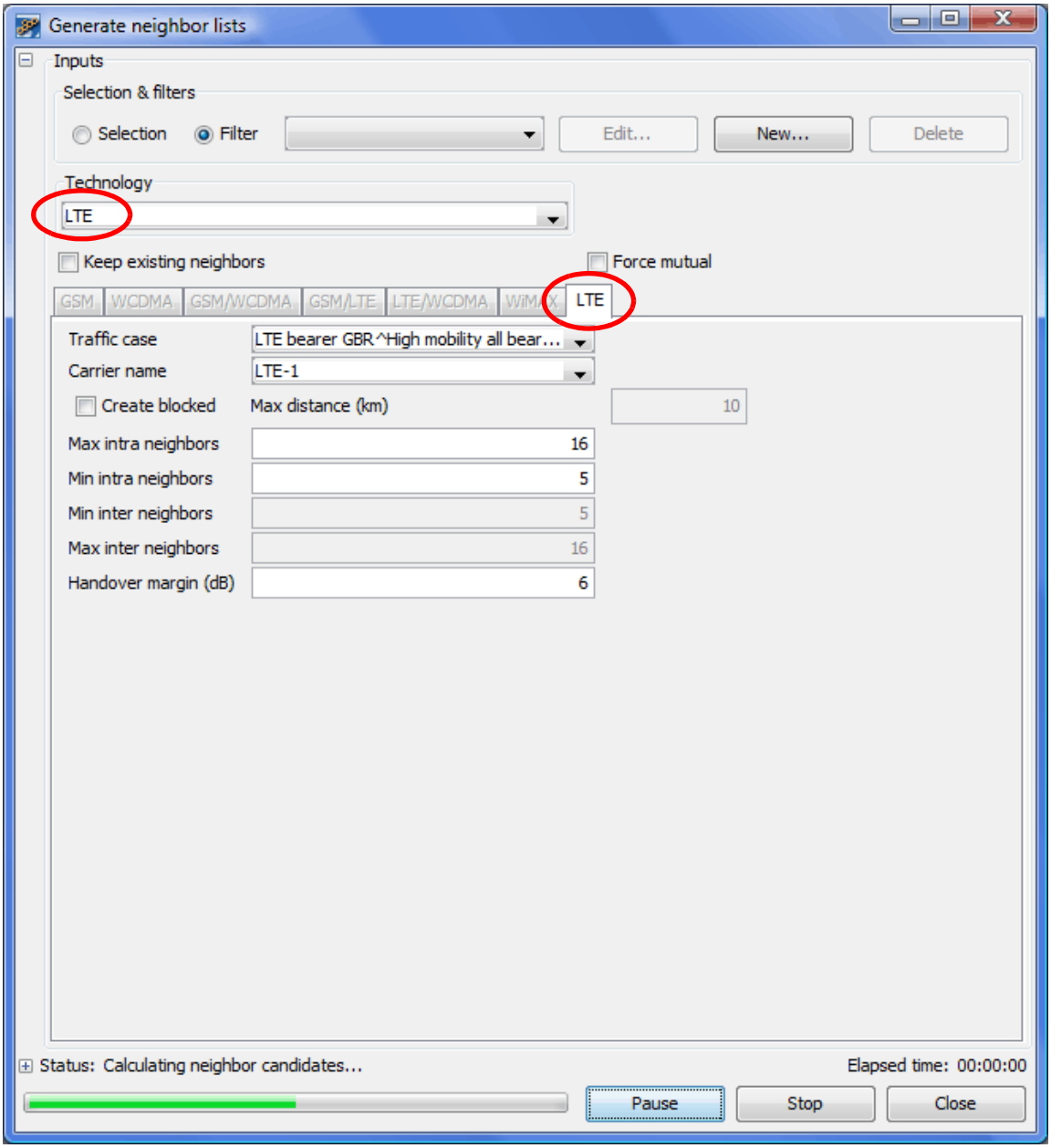
1. Select Analysis↗Neighbor list↗Generate neighbor lists to display the Generate neighbor lists window.
2. Optionally limit the number of cells to analyze by a Selection or Filter.
3. If you want to keep manually added neighbors from previous run of Generate LTE Neighbor Lists or from the neighbor cells in cell data, select option Keep existing neighbors.
4. If you want all relations to be mutual, select option Force mutual.
5. Select the type of neighbor lists to create, by selection from the Technology list:
   - LTE to Generate Intra-LTE Neighbor Lists
   - LTE to WCDMA, WCDMA to LTE, or LTE to/from WCDMA to Generate LTE-WCDMA Neighbor Lists
   - GSM to LTE, LTE to GSM, or GSM to/from LTE to Generate LTE-GSM Neighbor Lists
6. Select a Traffic case and Carrier for which to generate neighbor lists.
7. To block distant neighbors, select option Create blocked and enter a distance.
8. Modify the other parameters as required.

9. Click **Start** to generate the neighbor list. The **Evaluate neighbor lists** window is displayed.

Proceed with View Summary of Generated Neighbor Lists on page 12-35.

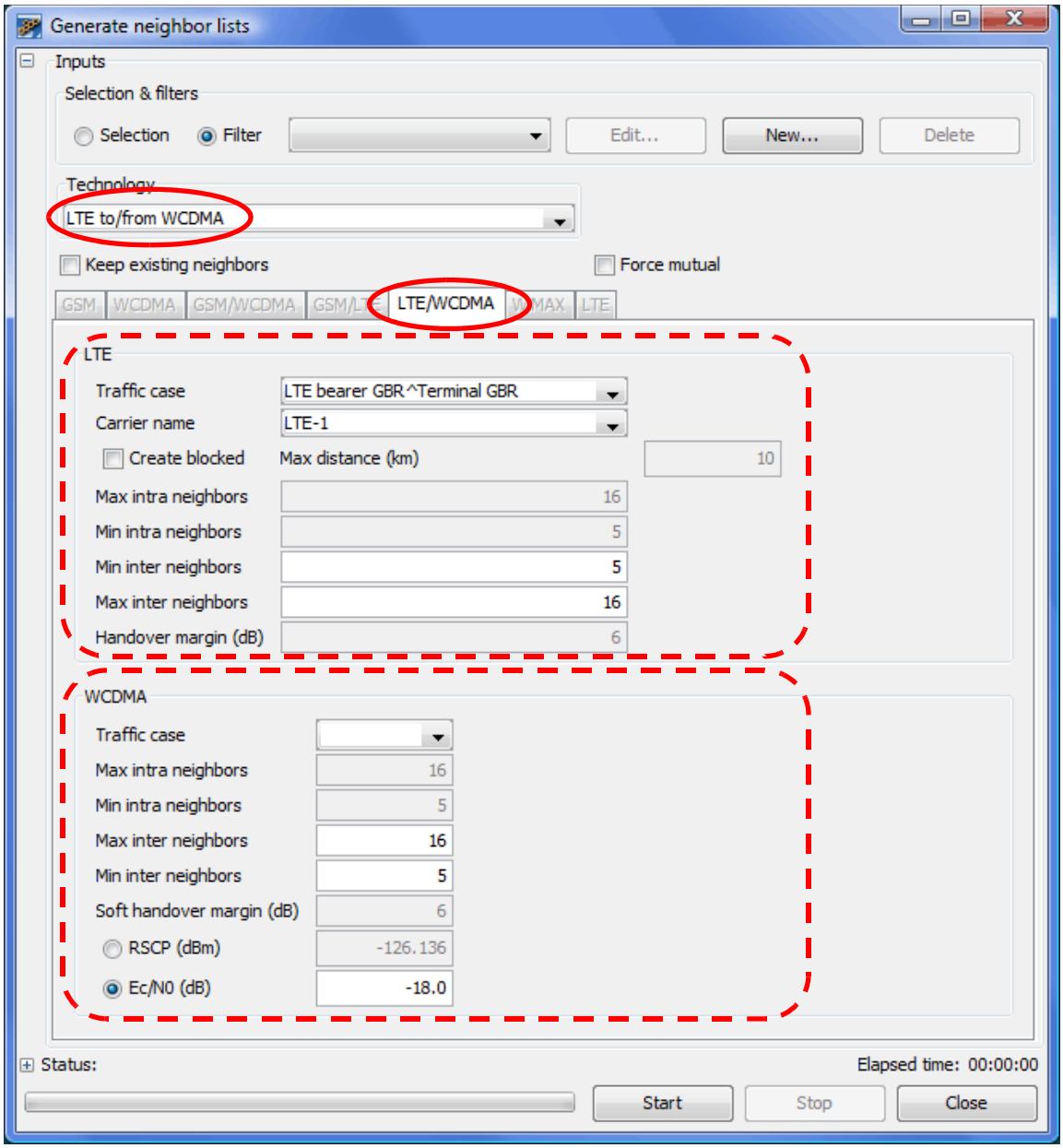
Generate Intra-LTE Neighbor Lists

The **Generate neighbor lists window** might look as in the following example when creation of intra-LTE neighbor lists is selected:



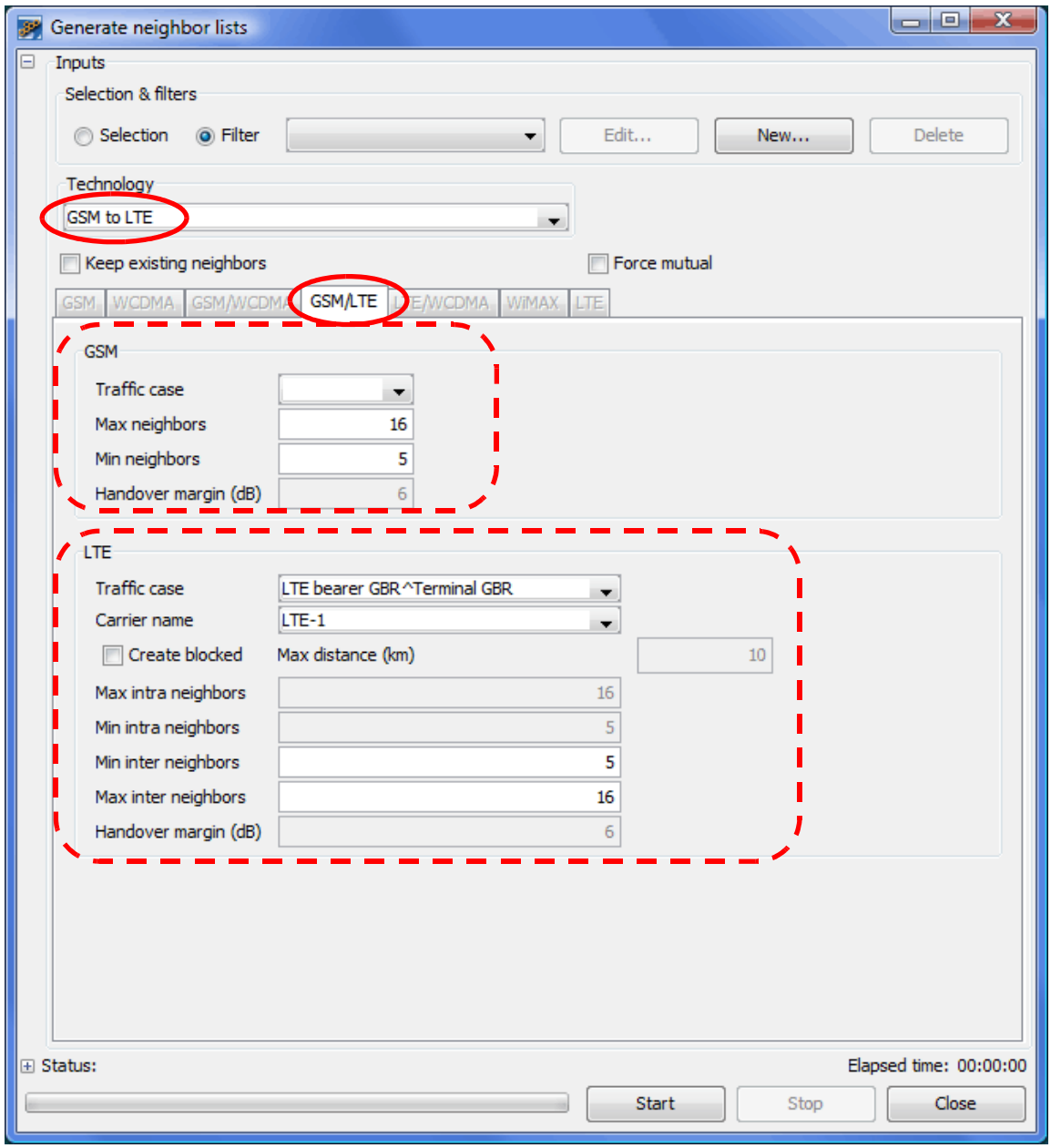
Generate LTE-WCDMA Neighbor Lists

The **Generate neighbor lists** window might look as in the example below when creation of LTE neighbor lists for WCDMA is selected. The parameters are described in Fields on Window "Generate Neighbor Lists" on page 12-35



Generate LTE-GSM Neighbor Lists

The **Generate neighbor lists** window might look as in the example below when creation of LTE neighbor lists for GSM is selected. The parameters are described in Fields on Window "Generate Neighbor Lists" on page 12-35.



Fields on Window "Generate Neighbor Lists"

Field	Description
Technology	The network technology to use for list generation.
Keep existing neighbors	Already generated neighbors are kept in the list during generation of a new neighbor list. Default: Not selected.
Force mutual	Makes all neighbor relations on the list mutual. Default: Not selected.
LTE part of the window	
Traffic case	The LTE traffic case to analyze. See Traffic Demands and Traffic Cases on page 12-6.
Carrier name	The LTE frequency carrier to analyze.
Create blocked	Option enabling the **Max distance** field
Max distance (km)	Neighbors located further away than this distance will be placed in the Blocked list. Minimum = 0. Default = 10 km.
Max intra neighbors	The maximum allowed amount of intra-frequency neighbors for an LTE cell. Range: 1-64. Initial = 16.
Min intra neighbors	The minimum allowed amount of intra-frequency neighbors for an LTE cell. Range: 1-64. Initial = 5.
Handover margin (dB)	Signal strength margin for handover. Range = 0-15. Initial = 6.0 dB.
WCDMA part of the window	
See parameter description in the *TEMS CellPlanner WCDMA User's Guide*	
GSM part of the window	
See parameter description in the *TEMS CellPlanner GSM User's Guide*	
Start/Pause, Stop, Close, Status, Next, Previous	

View Summary of Generated Neighbor Lists

Use this procedure to view a summary of the generated LTE neighbor lists.

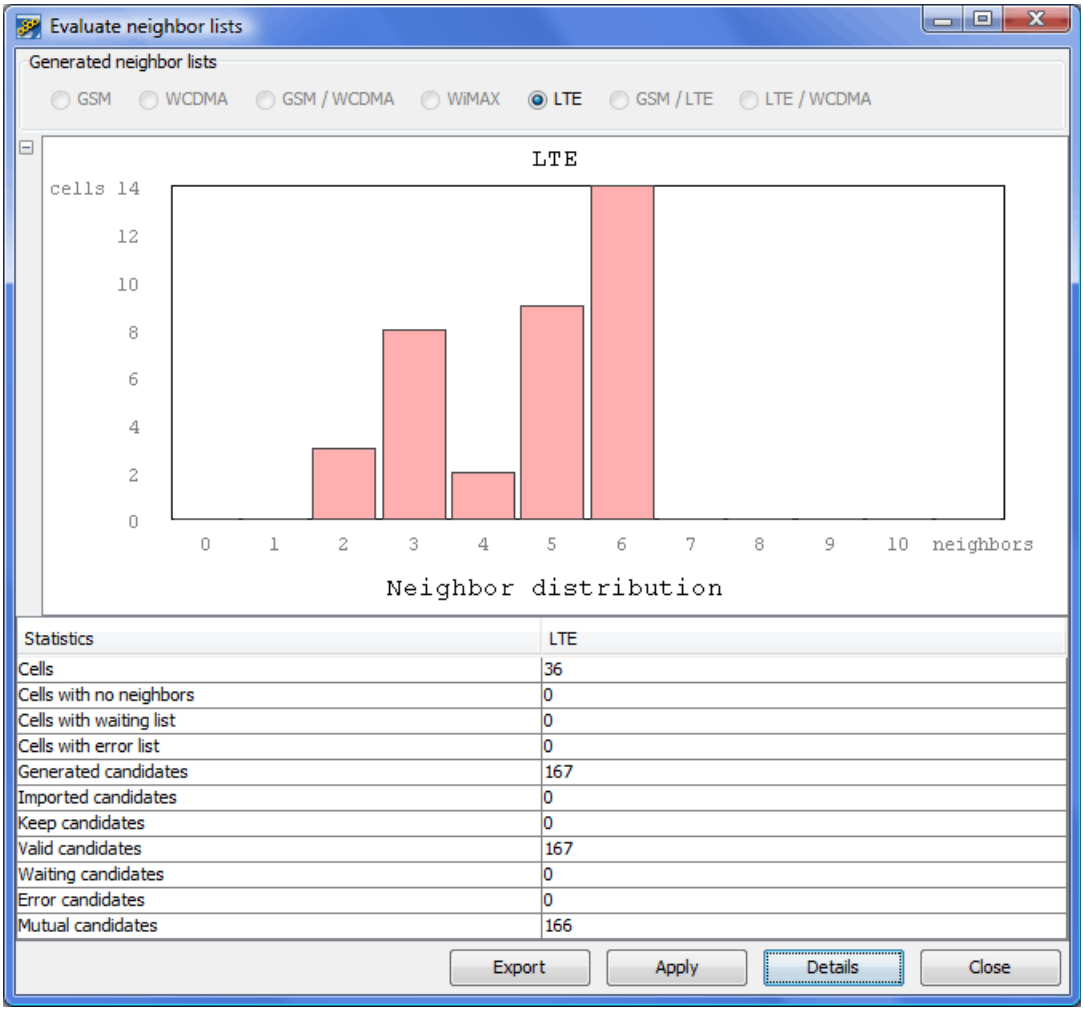
Prerequisites

Neighbors lists are available, see Generate LTE Neighbor Lists on page 12-30.

Procedure

Follow these steps to evaluate the neighbor analysis results:

1. Select **Analysis↗Neighbor list↗Evaluate neighbor lists** to open the **Evaluate neighbor lists** window. A graph and a table with statistics appear, as in the example below:



2. To view the generated neighbor lists in detail, click **Details** and follow the instructions in View Details of Generated Neighbor Lists on page 12-37.
3. To override the automatic selection of neighbors, follow the instructions in Modify Generated Neighbor Lists on page 12-40.
4. To extract the generated neighbor lists to a text file, click **Export**.

Important: To feed back the contents of the generated neighbor lists to the cell neighbor lists in the project, click **Apply**.

Fields on Window "Evaluate neighbor lists"

Field	Description
Generated neighbor lists	Selects the radio technology for which to display generated neighbor list. Selectable if neighbor lists from multiple radio technologies are available.
Neighbor distribution chart	Histogram over neighbor distribution. The x axis displays the number of neighbors, the y axis the number of cells. In the example there are 3 cells with 2 neighbors, 8 cells with 3 neighbors, and so forth.
(neighbor statistics)	The neighbor statistics of the analyzed traffic case: • Number of cells • Number of cells with no neighbors • Number of cells with waiting list • Number of cells with error list • Total number of generated candidates • Total number of imported candidates • Total number of keep candidates • Total number of valid candidates • Total number of waiting candidates • Total number of error candidates • Total number of mutual candidates
Export	Exports neighbor lists to a text file.
Apply	Applies the neighbor relations to the cell data.
Details	Shows details of the neighbor relations, see Modify Generated Neighbor Lists on page 12-40.

View Details of Generated Neighbor Lists

Use this procedure to view the generated neighbor lists of all analyzed cells. The **Neighbor list details** window displays a list of all analyzed cells and the neighbors found for each analyzed cell, together with the overlap percentage and status of the neighbor relation.

Prerequisites

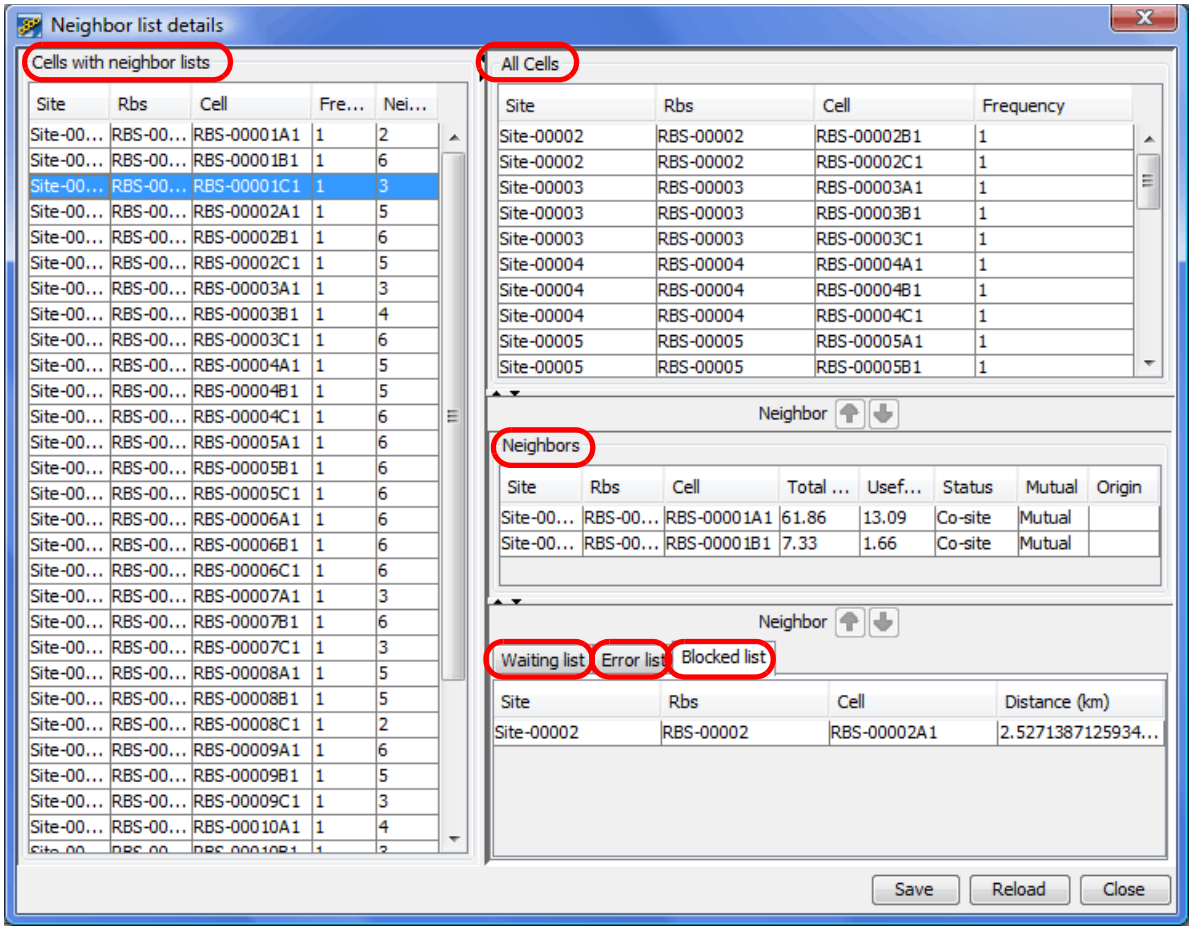
Generated neighbor lists are loaded, see Generate LTE Neighbor Lists on page 12-30.

Procedure

Follow these steps to view the neighbor analysis results:

1. Select **Analysis↗Neighbor list↗Evaluate neighbor lists**, see View Summary of Generated Neighbor Lists on page 12-35.

2. Click **Details**. The **Neighbor list details** window appears as in this example:



3. Analyze the contents in the lists.
   See Fields on Window "Neighbor List Details" on page 12-39.
4. To manually override the automatically generated neighbor lists, follow the instructions in Modify Generated Neighbor Lists on page 12-40.
5. To overwrite the displayed neighbor lists with a saved neighbor list from the calculation results directory, click **Reload**.
6. To keep the lists as they are, with or without manual modifications, click **Save**. The lists are saved in the calculation results directory and are retrieved the next time you Generate LTE Neighbor Lists. You can then select to **Keep existing neighbors** to not overwrite manual changes.

Important: If you wish to feed back the changes to the cell neighbor lists in the project, you must click **Apply** in the **Evaluate neighbor lists** window.

Fields on Window "Neighbor List Details"

Field	Description
Cells with neighbor lists	All cells analyzed by LTE Neighbor Analysis, listed on the left side of the window. One cell at a time can be selected from this list, and the result is shown in the right side of the window.
Relations to the cell selected from the list of **Cells with neighbor lists**:	
All cells	The cells not yet included in any of the other lists: **Neighbors**, **Waiting list**, **Error list**, or **Blocked list**.
Neighbors	Actual neighbor cells. This list initially includes the neighbor cells found to allow handover when you Generate LTE Neighbor Lists. You may manually place any cell on the neighbor list, even cells that were not found to be possible neighbors in the LTE Neighbor Analysis. Each cell in the list is described by among other the following parameters: Total overlap (%) — Overlap of cell neighbor area using the predicted signal strength. The area is expressed as a percentage of the neighbor cell's best server area. Useful overlap (%) — The area where the neighbor cell's signal strength is within the handover margin, that is, where a handover is likely to take place. The area is expressed as a percentage of the neighbor cell's best server area. Status = Co-site — Automatically generated relation, neighbor cell located in same RBS as the analyzed cell Status = Generated — Automatically generated relation with useful overlap Status = No useful overlap — Automatically generated relation, but without useful overlap Status = Added by user — Relation manually added by the user after generating the neighbor list. Status = Imported — Imported from **Import to neighbor list** Mutual — Possible values: • Mutual • Non-mutual relation - The neighbor cell has no neighbor relation to the analyzed cell. Handovers can only be done from the analyzed cell to the neighbor cell. Origin — The reason for the relation being in this list. Possible values: • (empty) - The relation is automatically generated • Added by user - Relation manually added by the user after generating the neighbor list

Field	Description
Waiting list	"Observation" list of candidate neighbor cells. This list initially includes candidate neighbors found when you Generate LTE Neighbor Lists. You may manually place any cell on the waiting list, even cells that were not found to be possible neighbors in the LTE Neighbor Analysis. Each cell in the list is described by among other the following parameters: Status = No useful overlap — None of the cells are within the handover margin. Candidates with no overlap within the handover margin are placed on the waiting list when the target cell's neighbor list has the minimum number of required neighbor relations. Status = Exceeded list length — Candidates on the waiting list are there because the list of qualified neighbors reached the allowed maximum.
Error list	Cells rejected as neighbor cells. This list initially includes possible neighbors found when the neighbor list is already full. You may manually place any cell on the error list. Each cell in the list is described by among other the following parameters: Status = Deleted by user — Neighbor relation manually removed from the neighbor list Status = Wanted by reverse neighbor — The target cell's neighbor list has reached its maximum number of neighbor relations; the option "Force mutual" has no effect.
Blocked list	Cells not allowed as neighbors due to being on the blacklist or being too distant. This list initially includes cells being too far away according to the distance entered when you Generate LTE Neighbor Lists. You may manually place any cell, for example blacklisted cells, on the blocked list. Each cell in the list is described by among other the following parameters: Distance (km) — Distance between target cell and neighbor cell
↑↓	Moves the selected cell to the list above or below the current list.
Save	Saves the neighbor list to the calculation results directory. You can later reload the saved list.
Reload	Reloads a saved neighbor list from the calculation results directory.

Modify Generated Neighbor Lists

Use this procedure to override automatically generated neighbor lists.

Prerequisites

Neighbor lists are currently viewed, see View Details of Generated Neighbor Lists on page 12-37.

Procedure

- To add a cell to the neighbor list, highlight the cell in another list (**All cells**, **Waiting list**, **Error list**, or **Blocked list**) and use the ↑ or ↓ arrows to move the cell to the **Neighbors** list.

Note: *Handover might not be possible between the analyzed cell and the added neighbor cell, as there is no check of the handover margin when moving relations manually.*

- To remove a cell from the neighbor list, highlight the cell in the **Neighbors** list and use the ↑ or ↓arrows to move the cell to any of the other lists: **All cells**, **Waiting list**, **Error list**, or **Blocked list**.
- To discard manual changes made before saving the changes, click **Reload**.
- To commit the modifications, click **Save**. The modified lists are saved in the calculations results directory.

Blacklist Cells in Generated Neighbor Lists

You can blacklist cells from being neighbors, although selected as neighbors when you Generate LTE Neighbor Lists. Do as when you Modify Generated Neighbor Lists, but move cells from any list to the **Blocked list**.

In the same way you can allow a blacklisted cell to become a neighbor by moving it from the **Blocked list** to any of the other lists.

Export Generated Neighbor Lists

You can export generated LTE neighbor lists to a text file as follows:

1. View Summary of Generated Neighbor Lists on page 12-35.
2. Click **Export** to extract the neighbor lists to a tab separated text file. The contents of the **Neighbor list** is exported. Note that the **Blocked list** is not exported, hence the text file includes no information about blacklisted cells.

See also Import Neighbors to Generated Neighbor List.

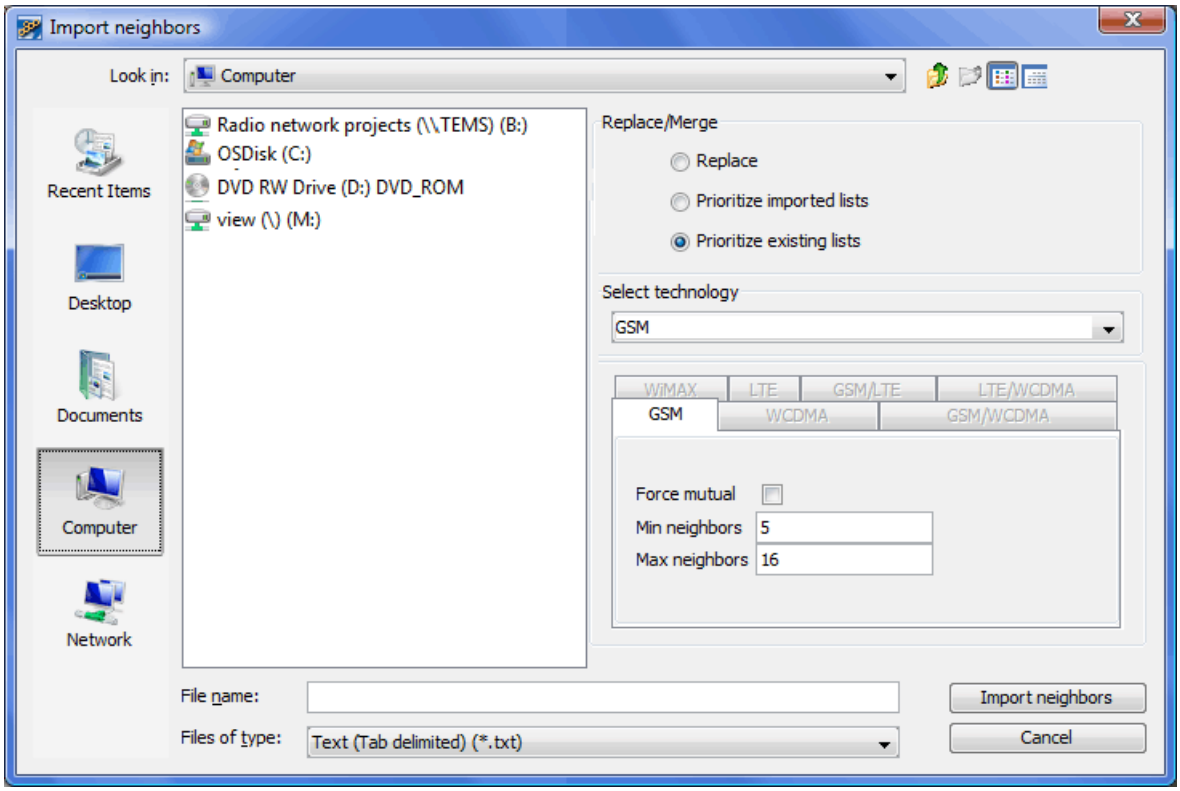
Note: *You cannot re-import this file.*

Import Neighbors to Generated Neighbor List

The format of the expected file the same as the one created in Export Generated Neighbor Lists. It is a tab separated text file with one row per cell, with the target cell to the left and all its neighbors listed on the row.

Do as follows to import a neighbor list file of this format and display it as a generated neighbor list.

1. Select **Analysis↗Neighbor list↗Import to neighbor list**. The import window appears as in the following example:



2. Select **LTE** as technology.
3. Select the file to import.
4. Select other parameters as desired.
5. Click **Import neighbors**.
6. Check the result and possibly save and apply the imported neighbors.
See View Summary of Generated Neighbor Lists on page 12-35

Important: If you wish to feed back the changes to the cell neighbor lists in the project, you must click **Apply** in the **Evaluate neighbor lists** window.

Troubleshooting Analysis Results

Only Same-Sited Cells as Neighbors

Sometimes a cell only gets neighbors in the same site according to the results from Generate LTE Neighbor Lists. The explanation is that the cell has no best server area, since it is completely overlapped by other, stronger cells.

You can solve this problem in different ways:

- If the cell appears as a non-mutual neighbor to surrounding cells, select the **Force mutual** box in the **Generate neighbor lists** window, or use the **Make mutual** button for the surrounding cells in the **LTE RBS explorer**.
- Enhance the coverage of the cell by increasing its power.
- Use a higher resolution in the pathloss prediction to obtain a more visible coverage of the cell.

13
LTE Plots

This chapter describes the plotted results from Monte Carlo analysis of an LTE network plan, taking into account the load and interference from surrounding LTE cells and terminal devices.

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- Pathloss Composite . . . 13-7
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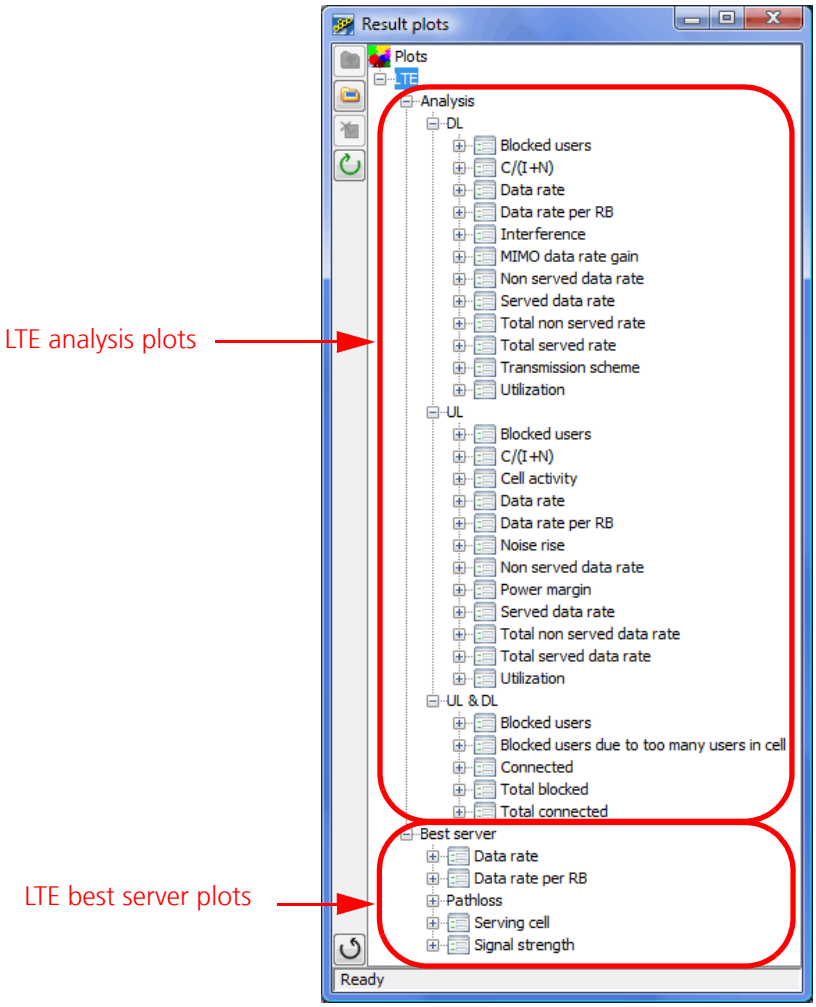
About LTE Plots

For generic information about plots, read chapter *Plots* in the *TEMS CellPlanner Common Features User's Guide*.

The LTE result plots selection window opened from **Analysis↗Result plots** might look as in the following example:



LTE Best Server Plots display pathloss, signal strength and serving cells in an unloaded network. The best server plots about data rate show the traffic performance under ideal conditions, without any interference.

LTE Analysis Plots show the traffical performance, power and interference situation in a loaded network where impact from surrounding cells and terminal devices are taken into account.

Plotted values can be extracted and written to a statistical report, as described in *Screen Statistics of Plots* in *TEMS CellPlanner Common Features User's Guide*.

LTE Best Server Plots

The result from Calculate LTE Best Servers can be displayed as plots, color coded for every bin served by the best serving cell. The subsequent pages describe and exemplify the best server plots for LTE.

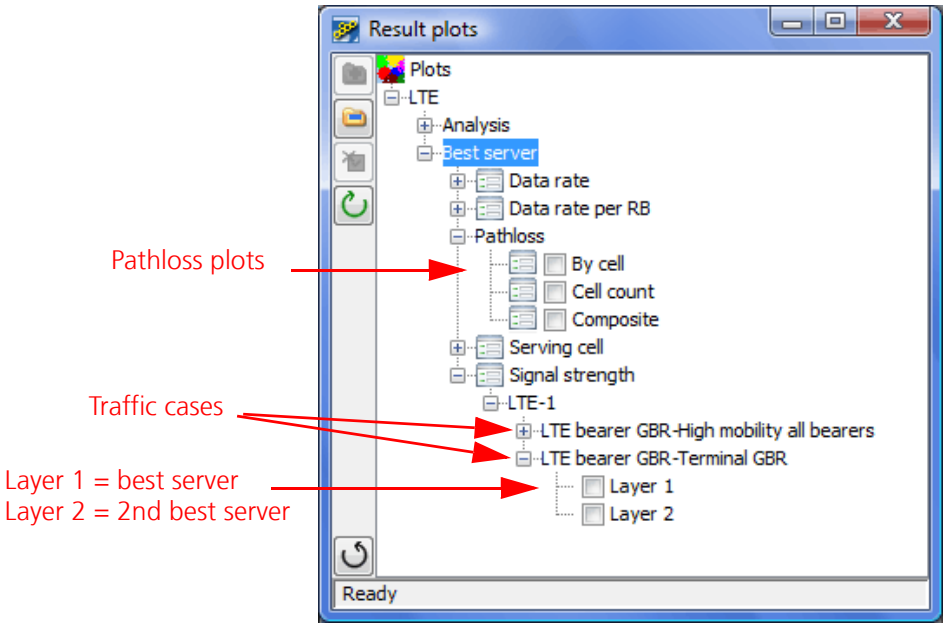
One set of the following plots are generated, accumulated for all frequencies and traffic cases:

- Pathloss Cell
- Pathloss Cell Count
- Pathloss Composite

The plots below are generated for each traffic case of the selected traffic demand mix. Only the cells supporting the selected carrier frequency are analyzed:

- (Uninterfered Instantaneous) DL Data Rate
- (Uninterfered Instantaneous) DL Data Rate per RB
- Serving Cell
- Signal Strength

The result plots window opened from **Analysis↗Result plots** including LTE best server plots might look as in the following example:

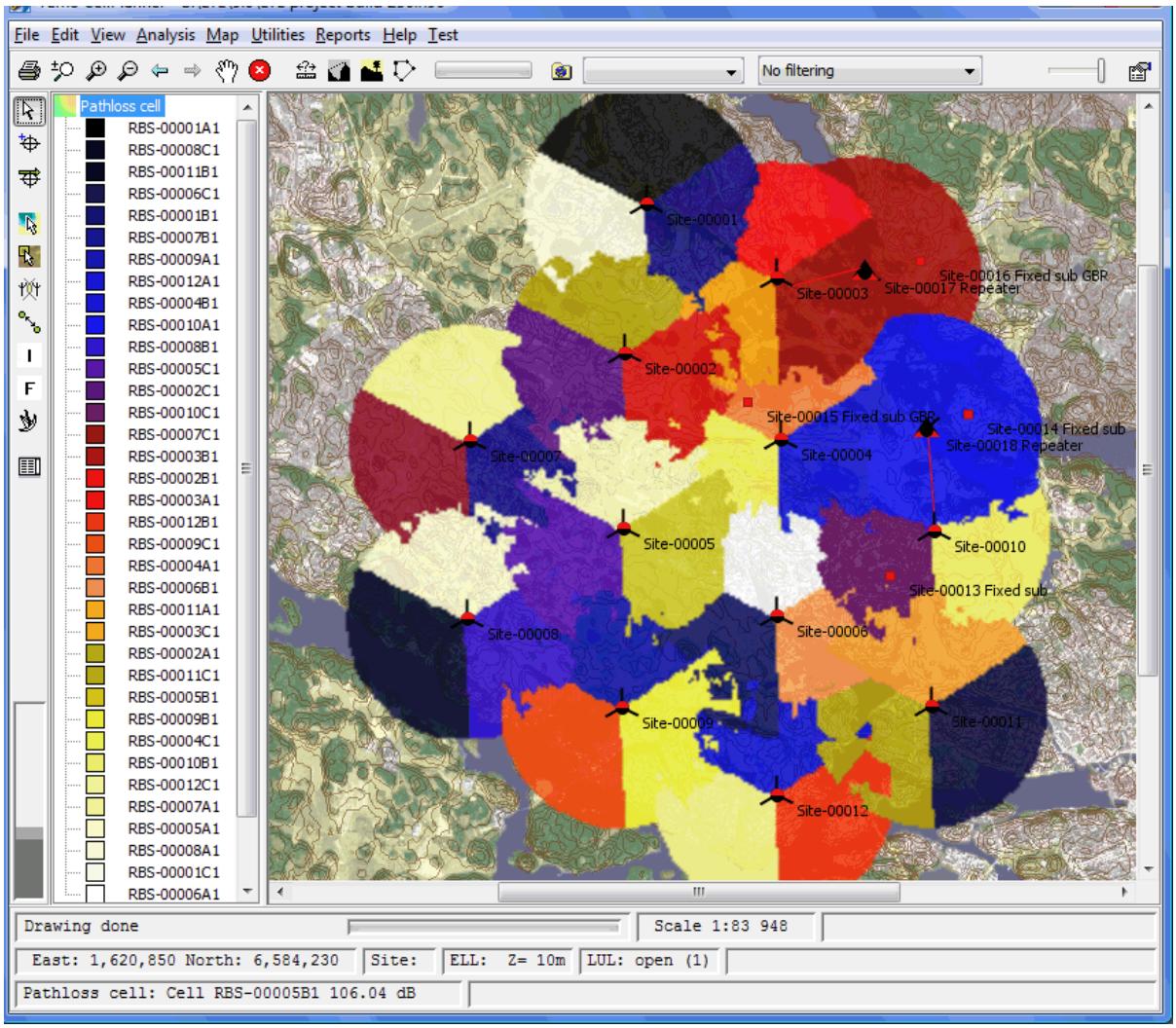


Pathloss Cell

This plot displays for each bin the cell with the lowest pathloss to the analyzed bin, that is, the *best server*, calculated over all frequencies and traffic cases.

The predicted pathloss in dB is displayed on the status bar together with the identity of the best serving cell.

The figure below shows an example of a pathloss cell plot:

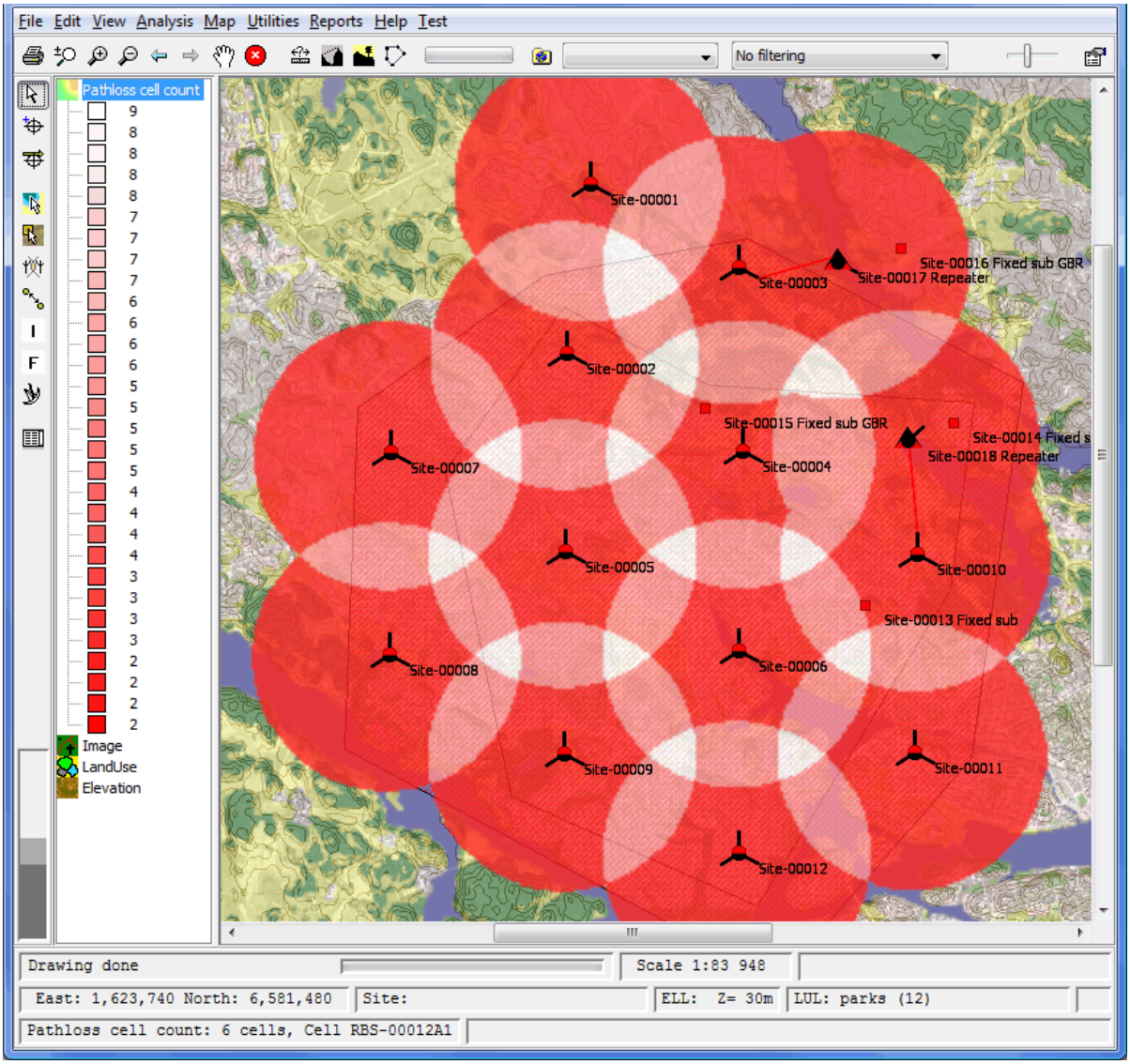


Pathloss Cell Count

This plot displays for each bin how many cells are taken into account when finding the best server, calculated over all frequencies and traffic cases.

The number of cells are displayed on the status bar for any position in the map.

The figure below shows an example of a pathloss cell count plot:

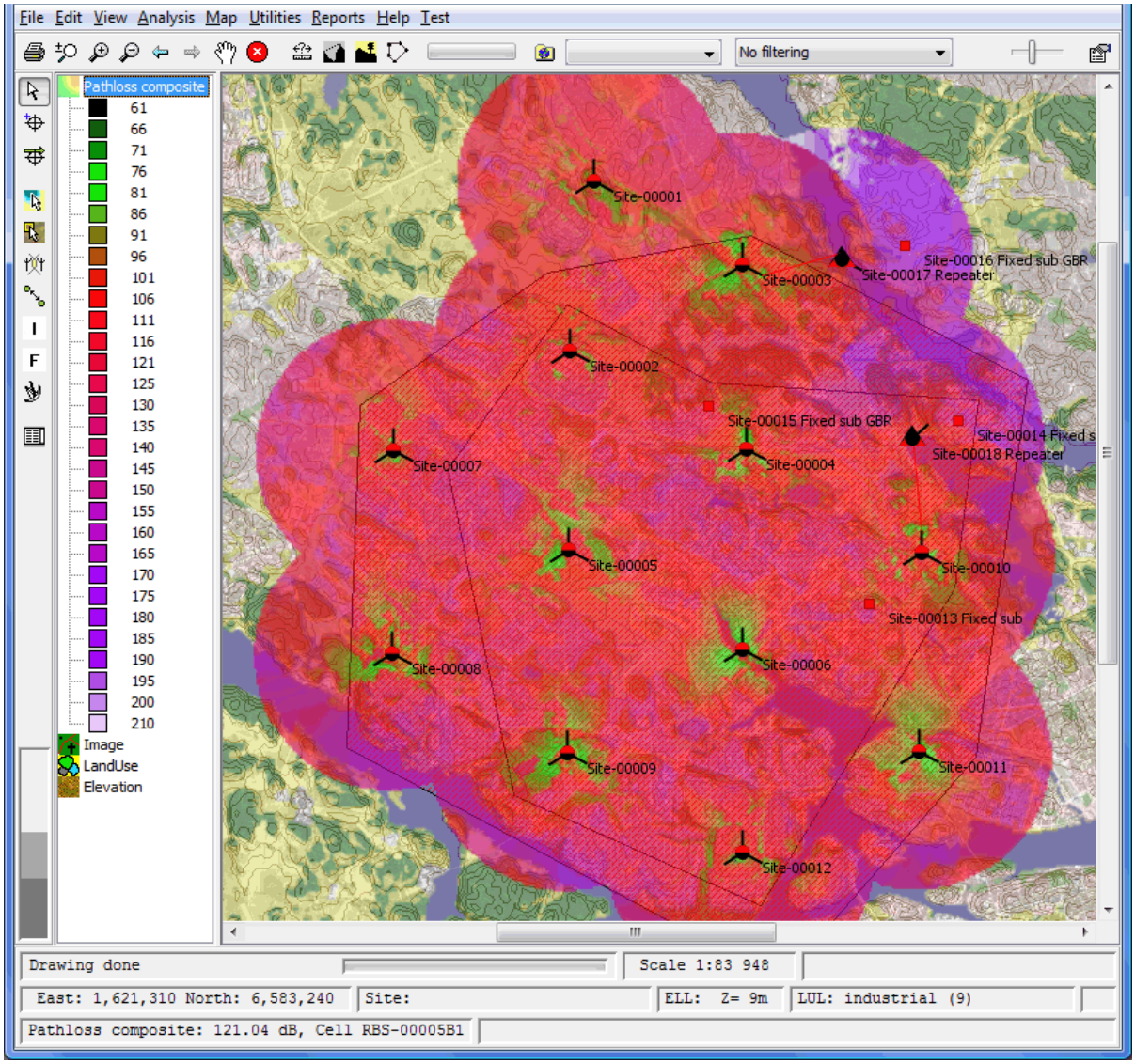


Pathloss Composite

This plot displays for each bin the lowest pathloss for all cells, for the analyzed frequency.

The predicted pathloss in dB is displayed on the status bar together with the identity of the best server, that is, the cell with the lowest pathloss to this bin.

The figure below shows an example of a composite pathloss plot:



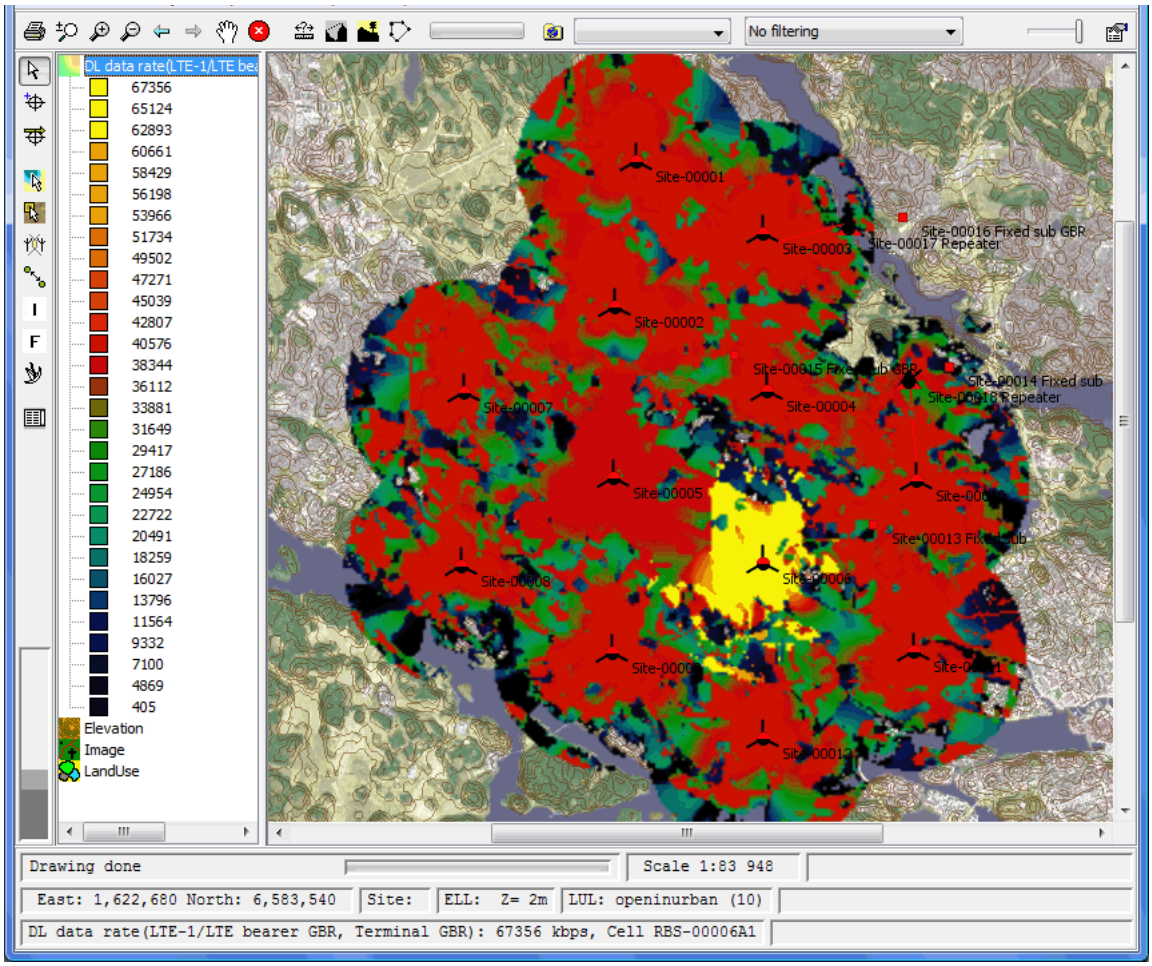
(Uninterfered Instantaneous) DL Data Rate

This plot displays for each bin the average ideal downlink data rate for the entire carrier (all resource blocks) without considering any interference, for the selected carrier frequency and traffic case.

The plot shows only the data rate perceived by a terminal type using the bearer of the selected traffic case.The achieved downlink data rate is the number of bits per second of traffic data received in all resource blocks (RBs) sent on the carrier frequency. The data rate of the whole carrier is calculated by multiplying the (Uninterfered Instantaneous) DL Data Rate per RB with the total number of RBs according to the LTE Carrier Mappings.

The DL data rate is displayed on the status bar together with the analyzed carrier frequency, the bearer and terminal type of the traffic case.

The figure below shows an example of a DL data rate plot without interference:

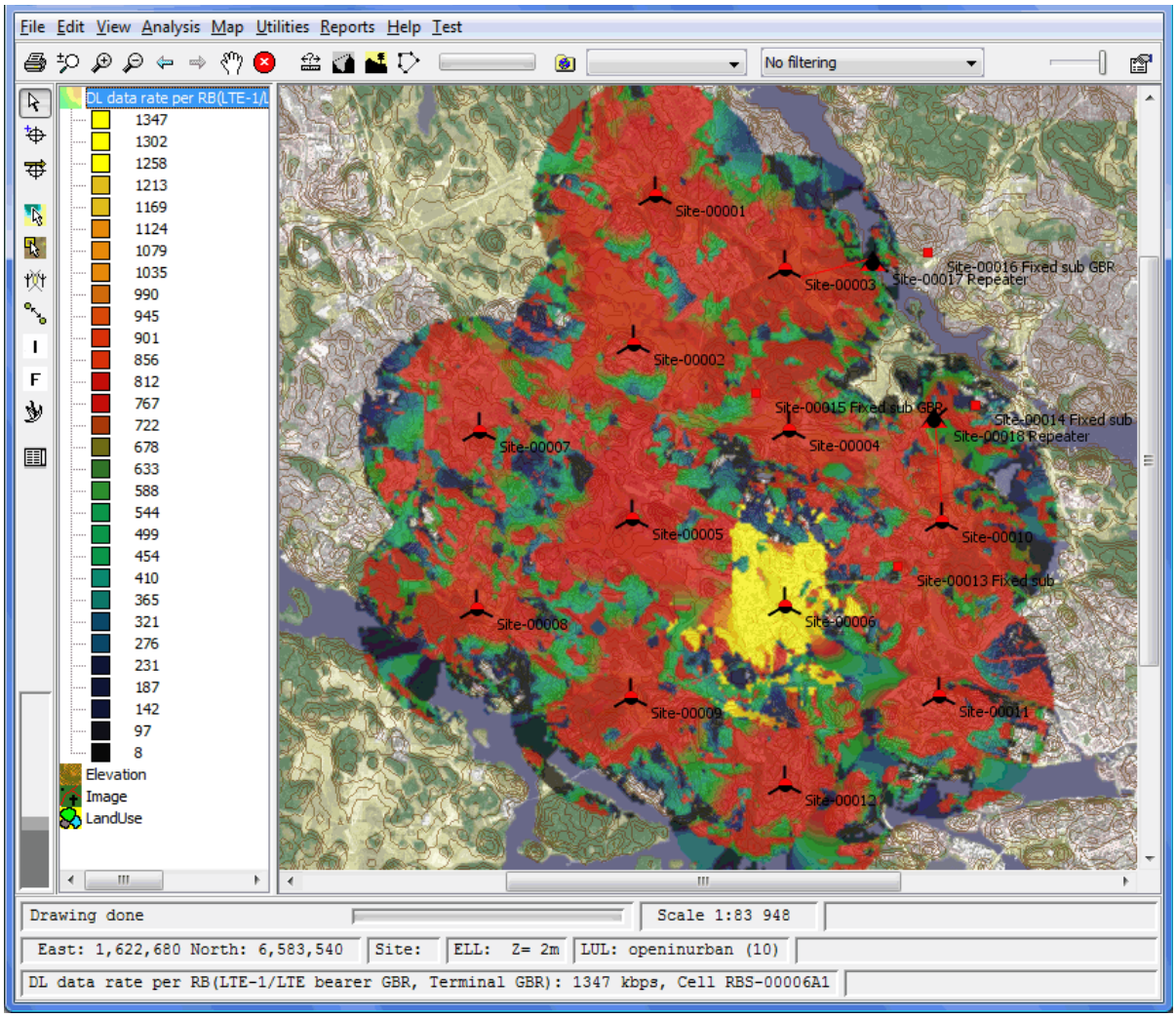


(Uninterfered Instantaneous) DL Data Rate per RB

This plot displays for each bin the average ideal downlink data rate per resource block (RB) without considering any interference, for the selected carrier frequency and traffic case. The plot shows the data rate perceived by a terminal type using the bearer of the selected traffic case. The achieved downlink data rate is the number of bits per second of traffic data received in one resource block (RB) sent on the carrier frequency.

The DL data rate per RB is displayed on the status bar together with the analyzed carrier frequency, the bearer and terminal type of the traffic case.

The figure below exemplifies a downlink data rate per RB plot without interference:



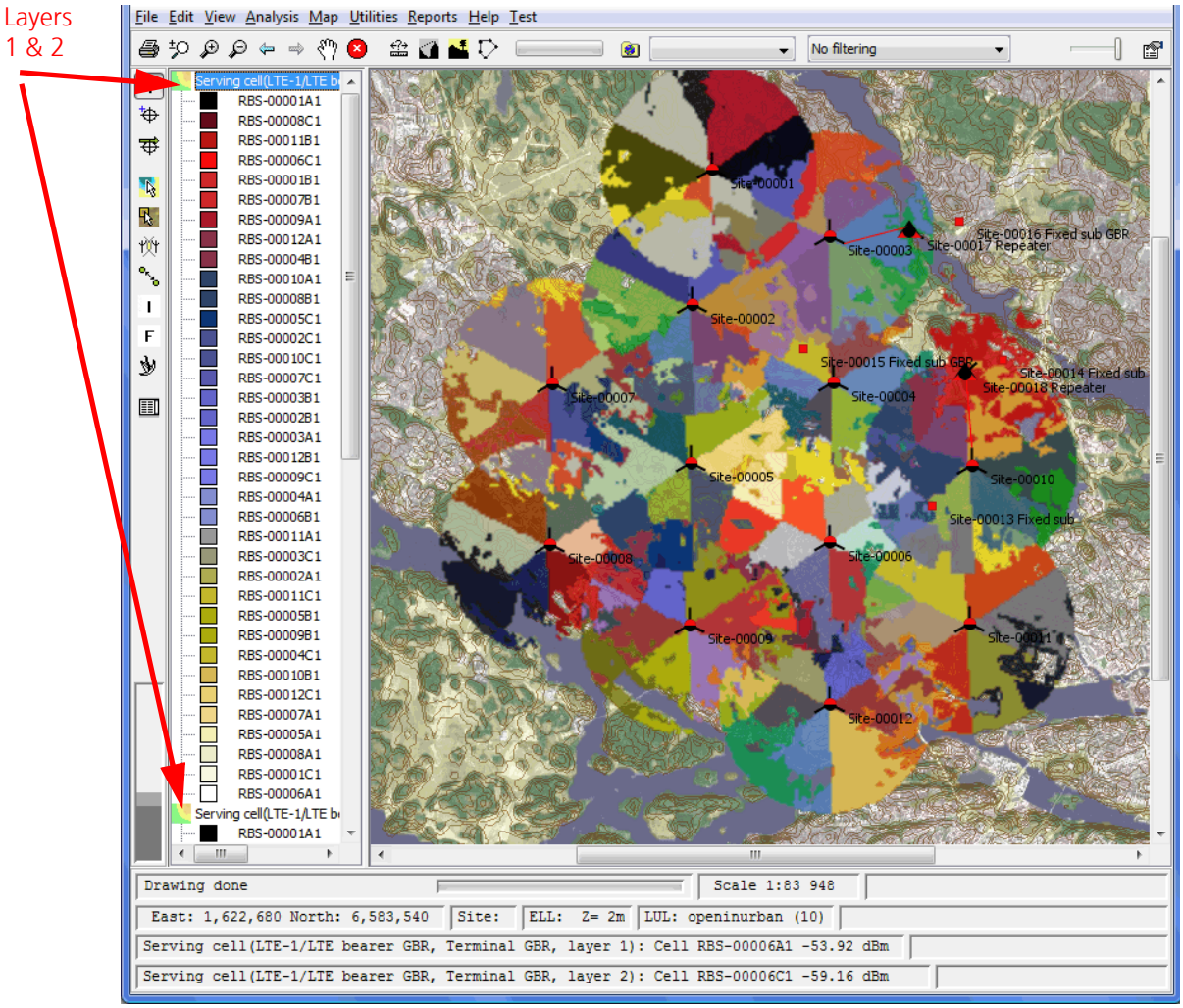
Serving Cell

This plot displays for each bin the best serving cell(s) for the selected carrier frequency and traffic case. (The similar plot Pathloss Cell displays the best serving cell for all frequencies and traffic cases).

For every bin, the cell with the strongest received signal is the best server. If the **Depth of best server list** equals 2 or more, the 2nd, 3rd … serving cells are the cells giving the 2nd, 3rd … highest received signal strength in a bin.

You select which layer(s) (N=1 for best server, N=2 for 2nd best server, and so on) to display. For the selected layer, the received signal strength in dBm (when the cell transmits at maximum power) is displayed on the status bar together with the identity of the Nth best serving cell(s), and the terminal and bearer of the analyzed traffic case.

The figure below shows an example of a serving cell plot with N=2, and best and 2nd best serving cell displayed simultaneously:



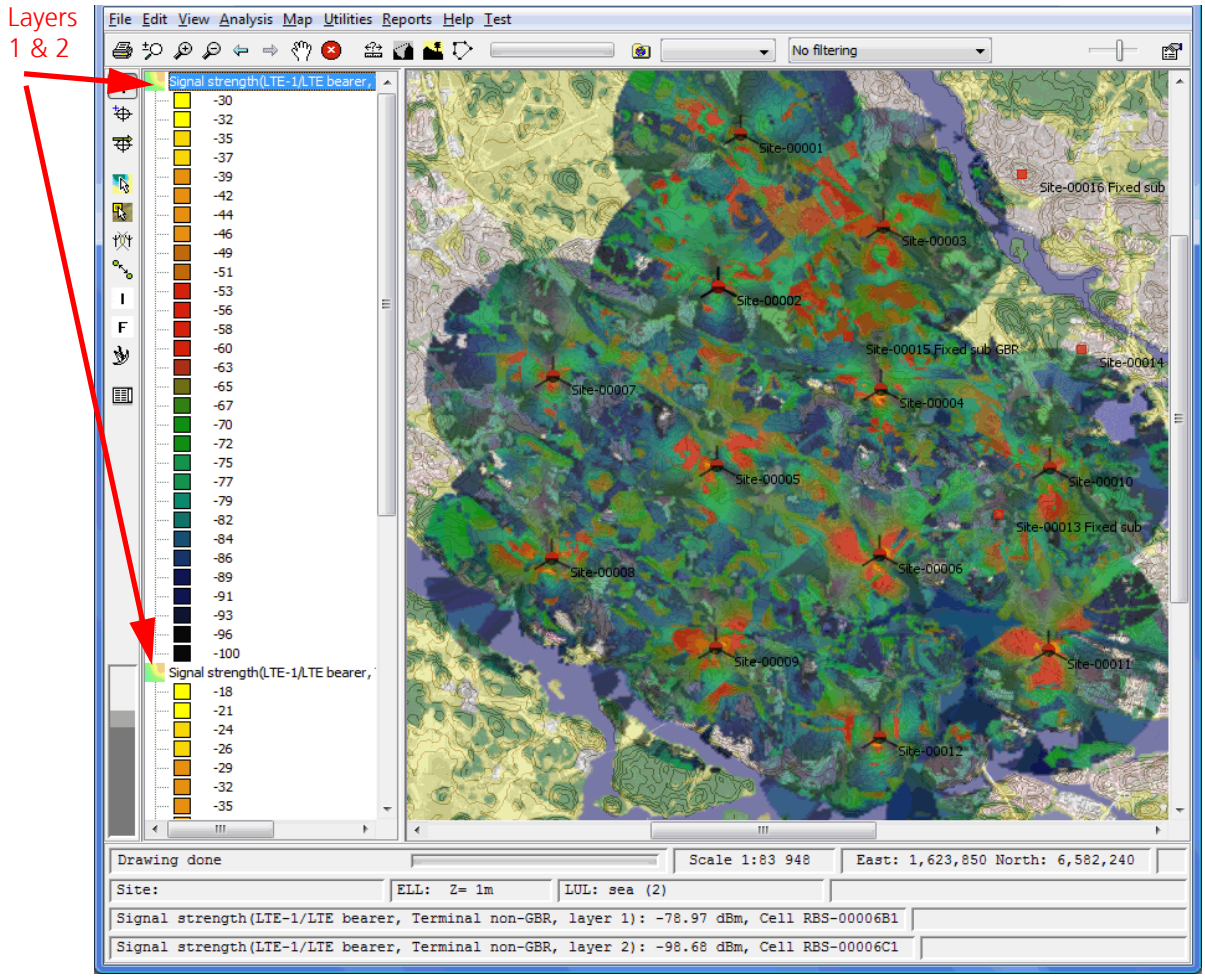
Signal Strength

This plot displays for each bin the received signal strength from the best server(s) for the selected carrier frequency and traffic case.

For every bin, the cell with the strongest received signal is the best server. If the **Depth of best server list** equals 2 or more, the 2nd, 3rd … serving cells are the cells giving the 2nd, 3rd … highest received signal strength in a bin.

You select which layer(s) (N=1 for best server, N=2 for 2nd best server, and so on) to display. For the selected layer, the received signal strength in dBm of the best serving cell (transmitting at maximum power) is displayed on the status bar together with the identity of the Nth best serving cell, and the terminal and bearer of the analyzed traffic case.

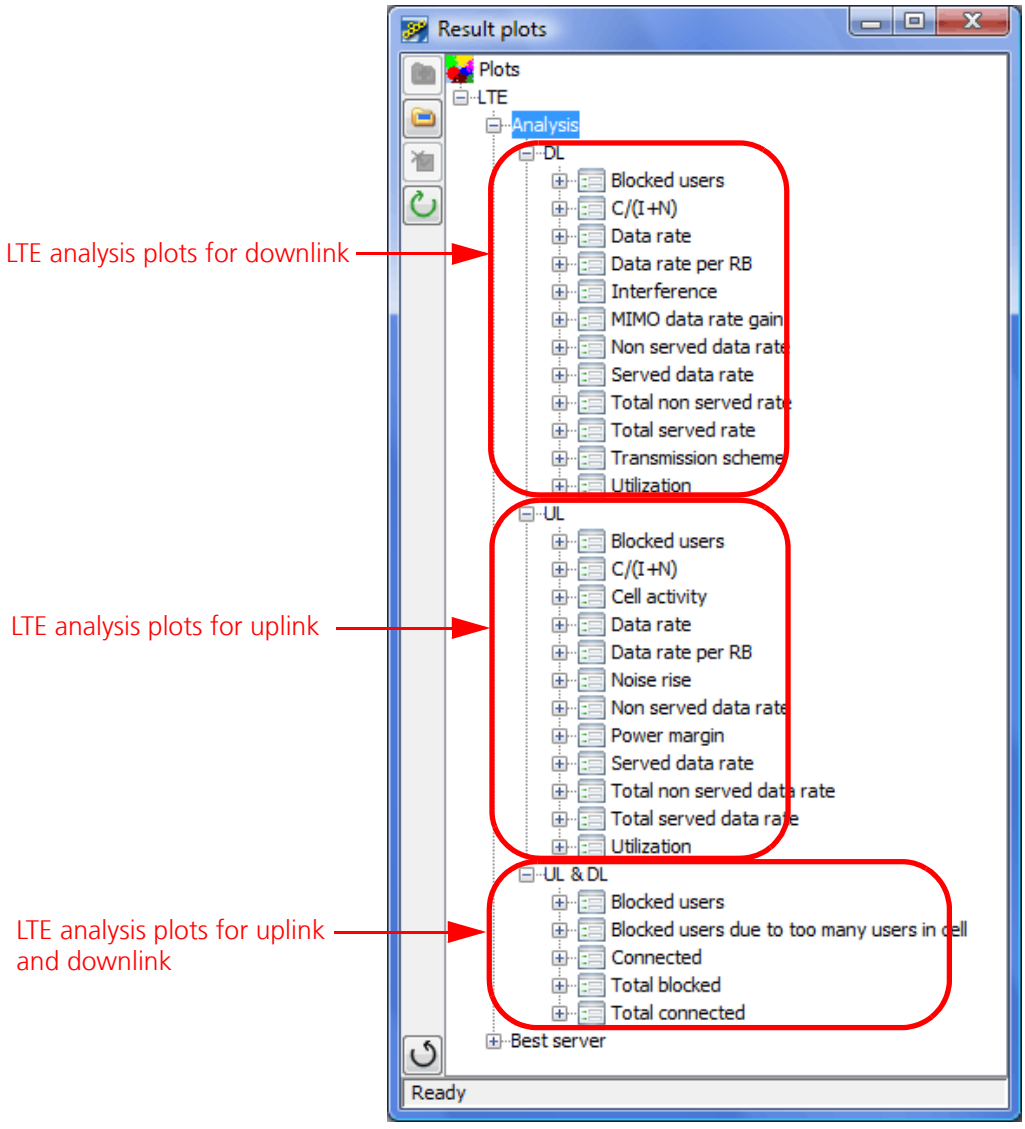
The figure below shows an example of a signal strength plot with best and 2nd best server displayed simultaneously:



LTE Analysis Plots

The results from LTE Analysis (Including Interference) can be displayed as plots, color coded for every bin in the analysis area.

You select LTE analysis plots to be displayed from the result plots window opened from **Analysis↗Result plots**. A list of the LTE analysis plots might look as below:



The plots are grouped as LTE Analysis Plots for Downlink, LTE Analysis Plots for Uplink, and LTE Analysis Plots for Uplink & Downlink.

Plots are generated for the selected carrier frequency and each traffic case of the selected traffic demand mix. The status bar displays the plotted value together with

the carrier frequency, the traffic case (bearer and terminal type), and the identity of the best serving cell.

Mots plot values are traffic case specific, but some are accumulated for all traffic cases and the status bar then displays the same (summed) value for any traffic case.

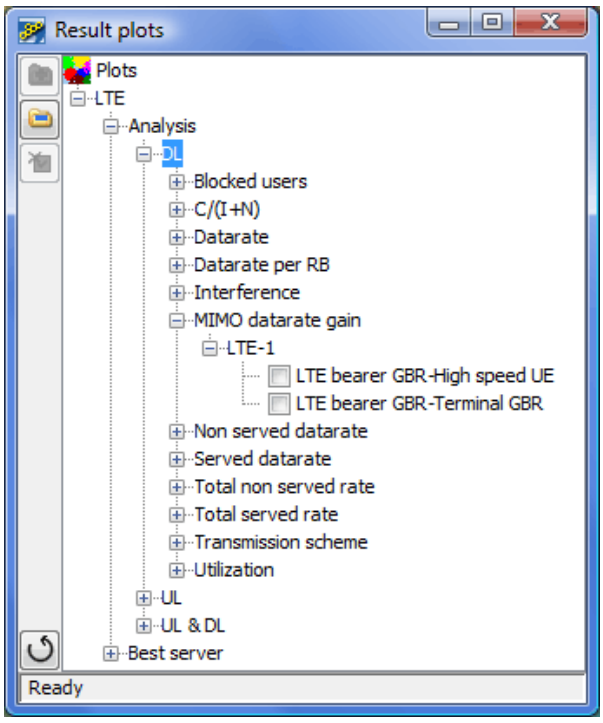
See also how to generate a textual LTE Analysis Report.

LTE Analysis Plots for Downlink

The subsequent pages describe and exemplify available downlink LTE Analysis Plots, generated for the selected carrier frequency and each traffic case of the selected traffic demand mix:

- Users Blocked in DL
- DL C/(I+N)
- (Instantaneous) DL Data Rate (with Interference)
- (Instantaneous) DL Data Rate per RB (with Interference)
- DL Interference
- DL MIMO Data Rate Gain
- (Average) DL Non Served Data Rate
- (Average) DL Served Data Rate
- (Average) DL Total Non Served Data Rate - summed over all traffic cases
- (Average) DL Total Served Data Rate - summed over all traffic cases
- DL Transmission Scheme
- DL Utilization - summed over all traffic cases

The result plots window opened from **Analysis↗Result plots** including downlink LTE analysis plots might look as in the following example:



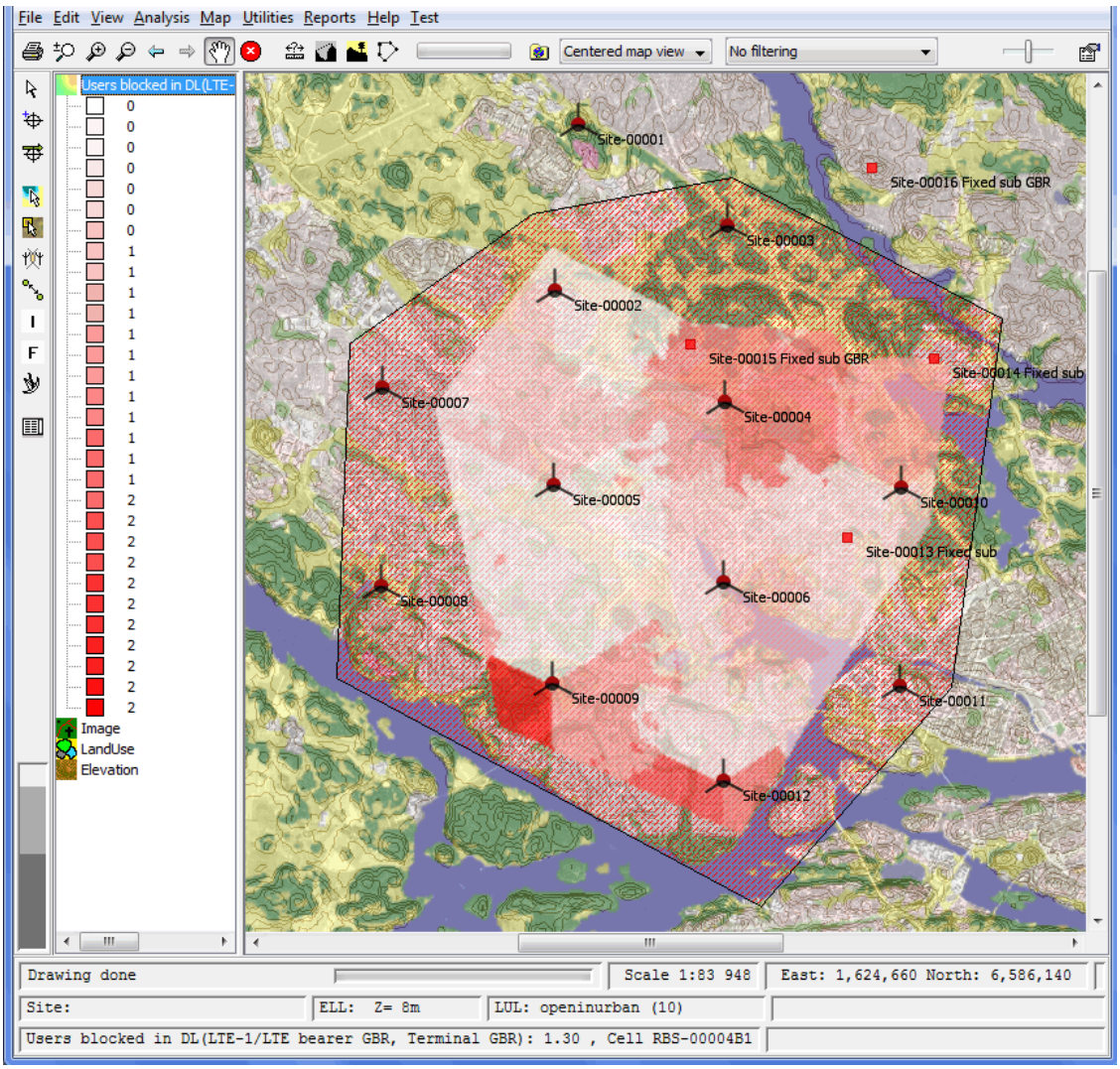
Users Blocked in DL

This plot displays for each cell the average number of non-served users in downlink, for the selected carrier frequency and traffic case. The value is plotted in all bins belonging to the best server area of each cell.

The status bar displays the number of blocked (not served) users together with the traffic case and the identity of the best serving cell.

The various reasons for blocking (not serving) users are described in the *TEMS CellPlanner LTE Technical Reference Manual*.

The figure below exemplifies a plot showing number of users blocked in downlink:



You can also generate an LTE Analysis Report showing the average number of blocked (not served) users per traffic case and cell. Statistics are available for any or specific blocking reasons.

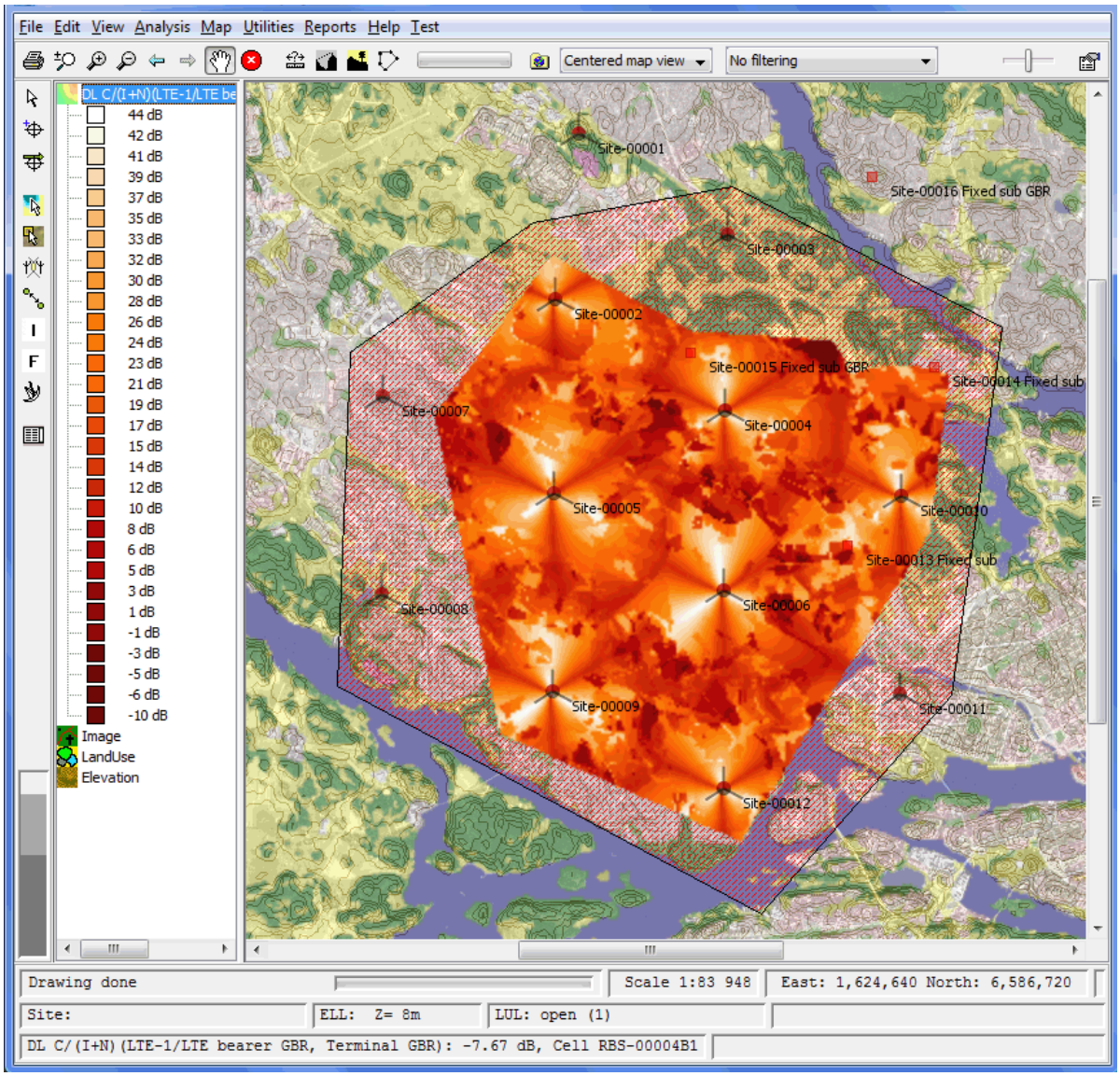
DL C/(I+N)

This plot displays for each bin the average DL C/(I+N) in dB, for the selected carrier frequency and traffic case.

The DL C/(I+N) is displayed on the status bar together with the identity of the best serving cell, the carrier frequency, and the bearer and terminal of the traffic case.

A DL Interference plot is generated together with the DL C/(I+N) plot.

The figure below shows an example of a DL C/(I+N) plot:



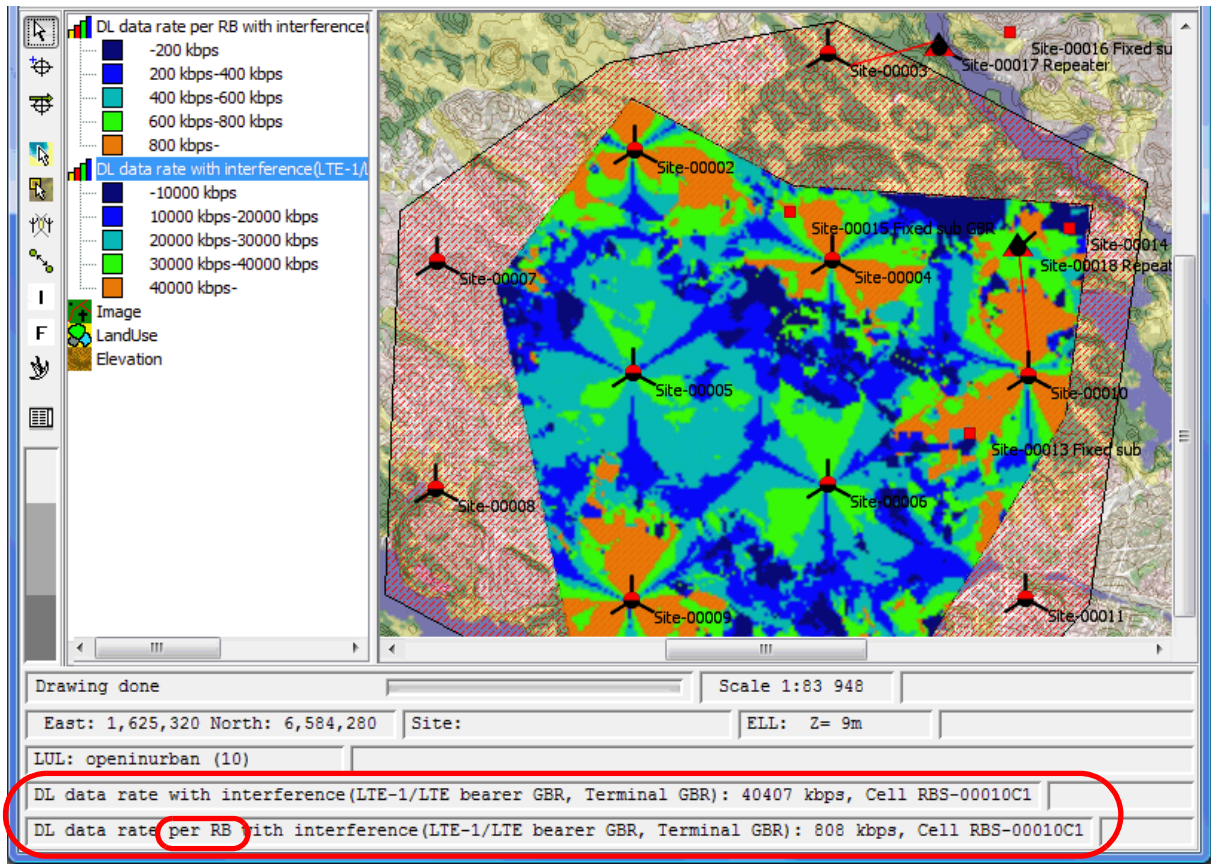
(Instantaneous) DL Data Rate (with Interference)

This plot displays for each bin the instant downlink data rate in kbps received in all resource blocks (RBs) sent on the carrier frequency for the selected traffic case, with DL Interference from surrounding users and cells taken into account. (The similar plot (Uninterfered Instantaneous) DL Data Rate assumes no interference). The DL data rate of the whole carrier is calculated by multiplying the (Instantaneous) DL Data Rate per RB (with Interference) with the number of RBs set in the LTE Carrier Mappings.

In detail, this plot shows the data rate given to users at connection establishment, while the plot (Average) DL Served Data Rate shows the average data rate over time. The data rate values in this plot may exceed the average requested data rate, while the values in plot (Average) DL Served Data Rate are limited by the average requested data rate.

The DL data rate with interference is displayed on the status bar together with the identity of the serving cell, the carrier frequency, and the bearer and terminal type of the traffic case.

In the example below the plots (Instantaneous) DL Data Rate (with Interference) and (Instantaneous) DL Data Rate per RB (with Interference) are displayed simultaneously



You can also generate an LTE Analysis Report showing the average achieved DL data rate per traffic case and cell.

(Instantaneous) DL Data Rate per RB (with Interference)

The plot (Instantaneous) DL Data Rate per RB (with Interference) is similar to the (Instantaneous) DL Data Rate (with Interference) but it displays the data rate received in only one resource block (RB) sent on the carrier frequency for the selected traffic case.

The DL data rate per RB is retrieved from the terminal type's downlink Data Rate Mapping.

See example in (Instantaneous) DL Data Rate (with Interference) on page 13-17.

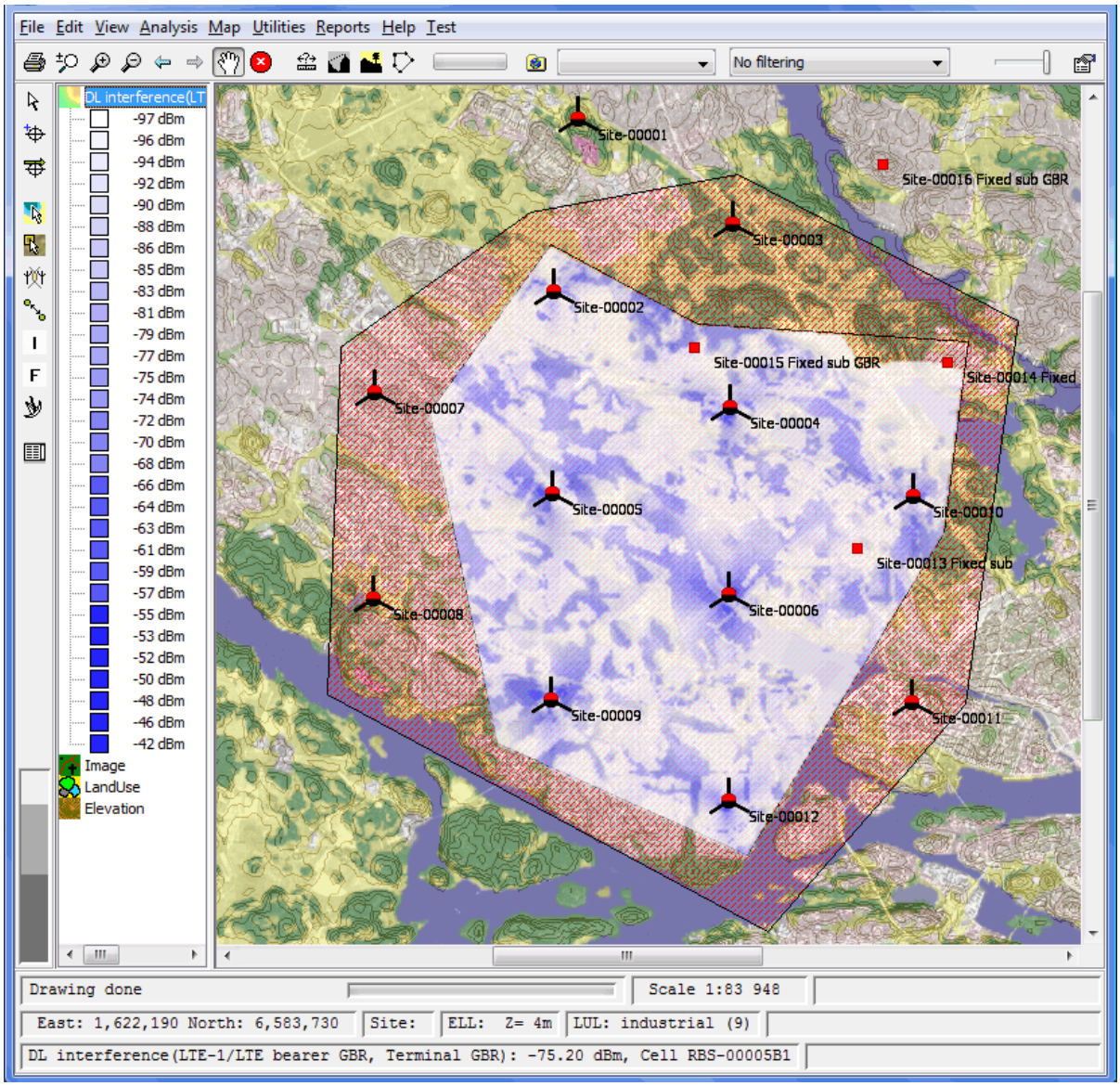
DL Interference

This plot displays for each bin the downlink interference plus noise (I+N) for the selected carrier frequency and traffic case. The interference is measured in dBm.

The (I+N) value is displayed on the status bar together with the identity of the best serving cell, the carrier frequency, and the bearer and terminal of the traffic case.

A DL C/(I+N) plot is generated together with the DL interference plot.

The figure below shows an example of a DL interference plot:



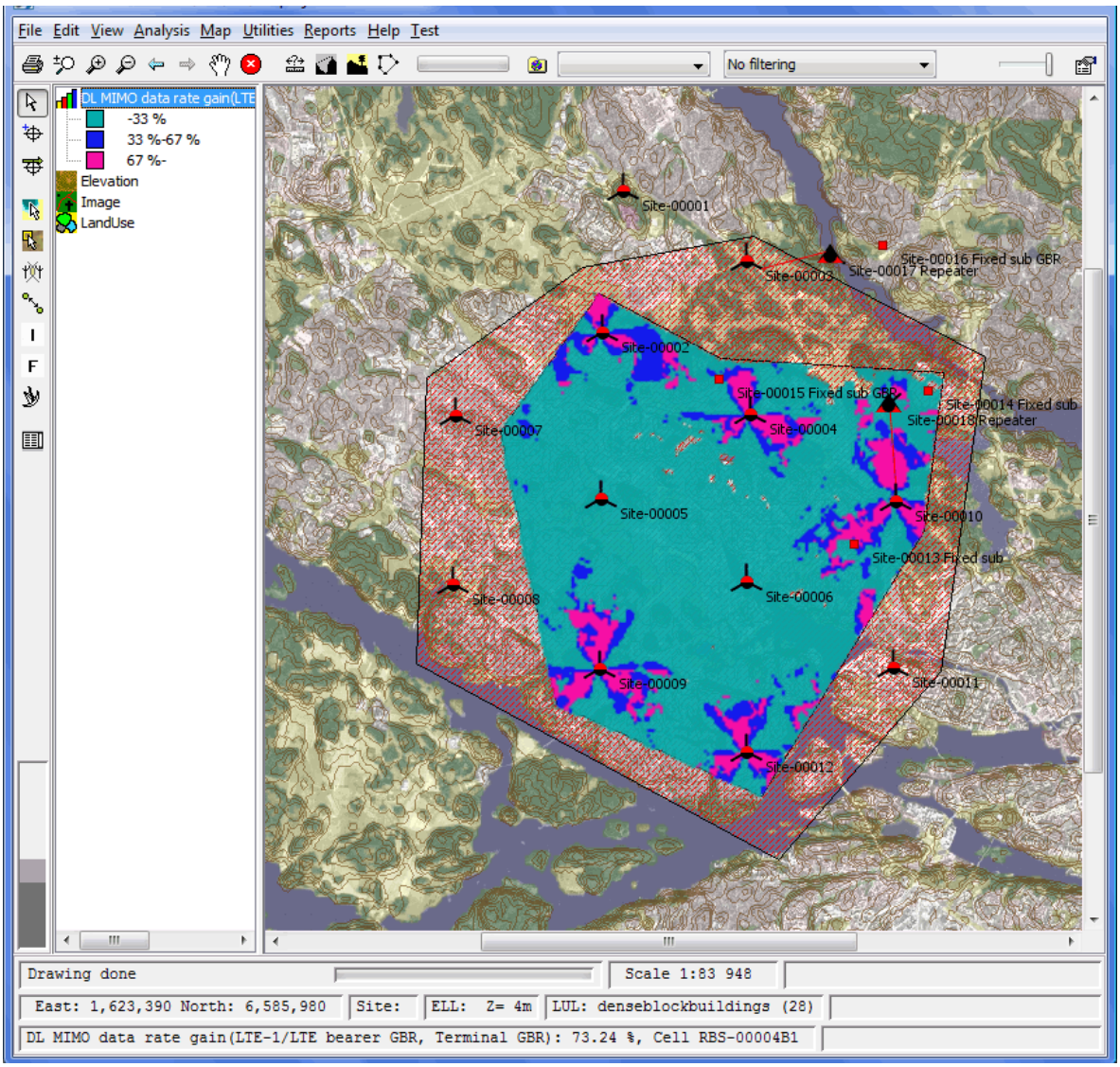
DL MIMO Data Rate Gain

This plot displays for each bin the DL data rate increase in % when 2x2 MIMO is used compared to when 2x2 Tx diversity is used, for the selected carrier frequency and traffic case. The plot can give you guidance about where use of 2x2 MIMO is favorable in terms of throughput.

The data rate increase is expressed in per cent of the data rate for Tx diversity. Negative values indicate that Tx diversity would give higher bit rates.

The DL data rate increase is displayed on the status bar together with the identity of the best serving cell, the carrier frequency, and the bearer and terminal of the traffic case. Negative values mean that Tx diversity gives higher rate than MIMO.

The figure below shows an example of a MIMO data rate gain plot:



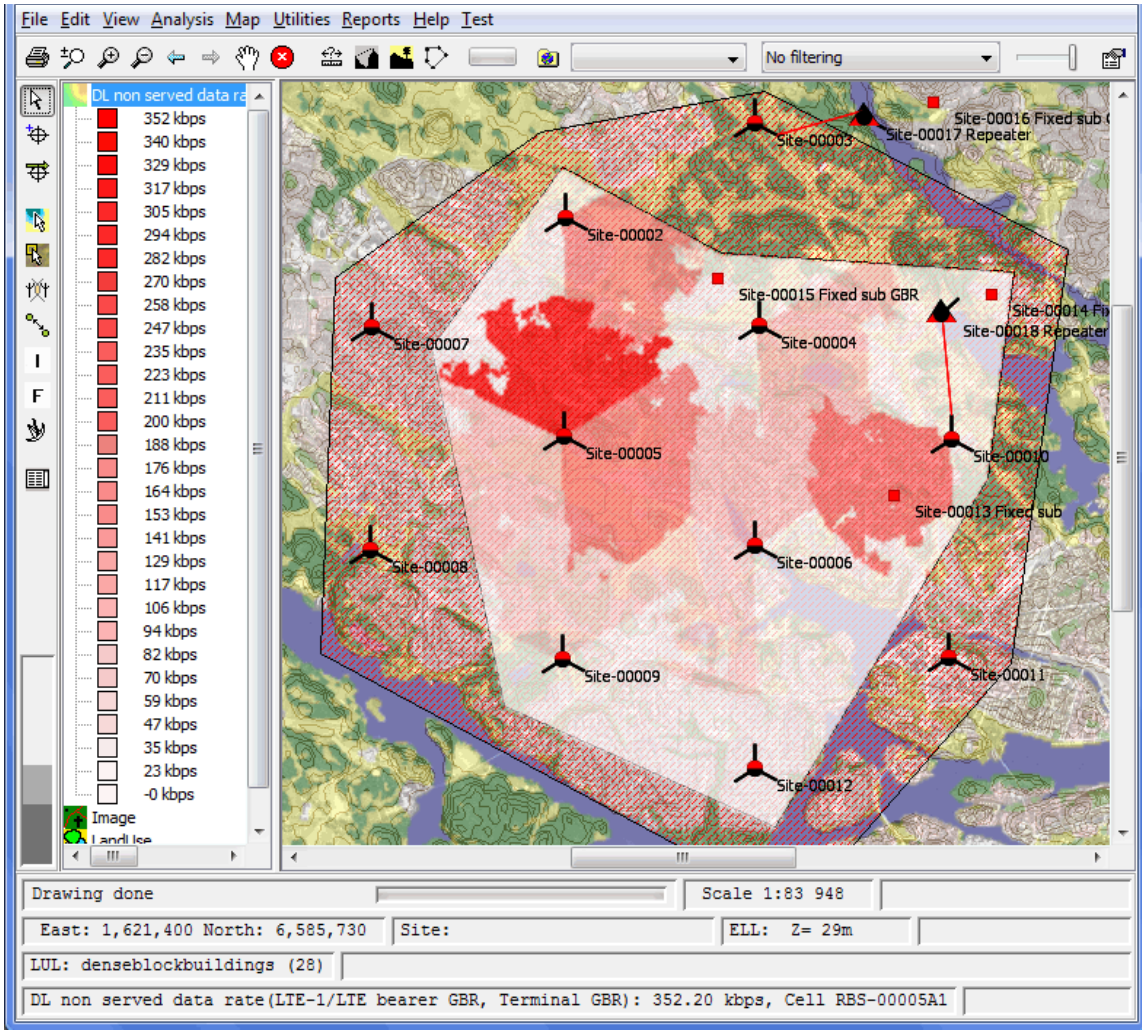
(Average) DL Non Served Data Rate

This plot displays for each cell the average downlink cell capacity that is not consumed in the cell, for the selected carrier frequency and per traffic case. The value is plotted in all bins belonging to the best server area of each cell.

The not used cell capacity is displayed on the status bar together with the identity of the best serving cell, the carrier frequency, and the bearer and terminal of the traffic case.

The various reasons for blocking (not serving) users are described in the *TEMS CellPlanner LTE Technical Reference Manual*.

The figure below shows a DL non served data rate plot:



You can also generate an LTE Analysis Report showing the average not served data rate per traffic case and cell.

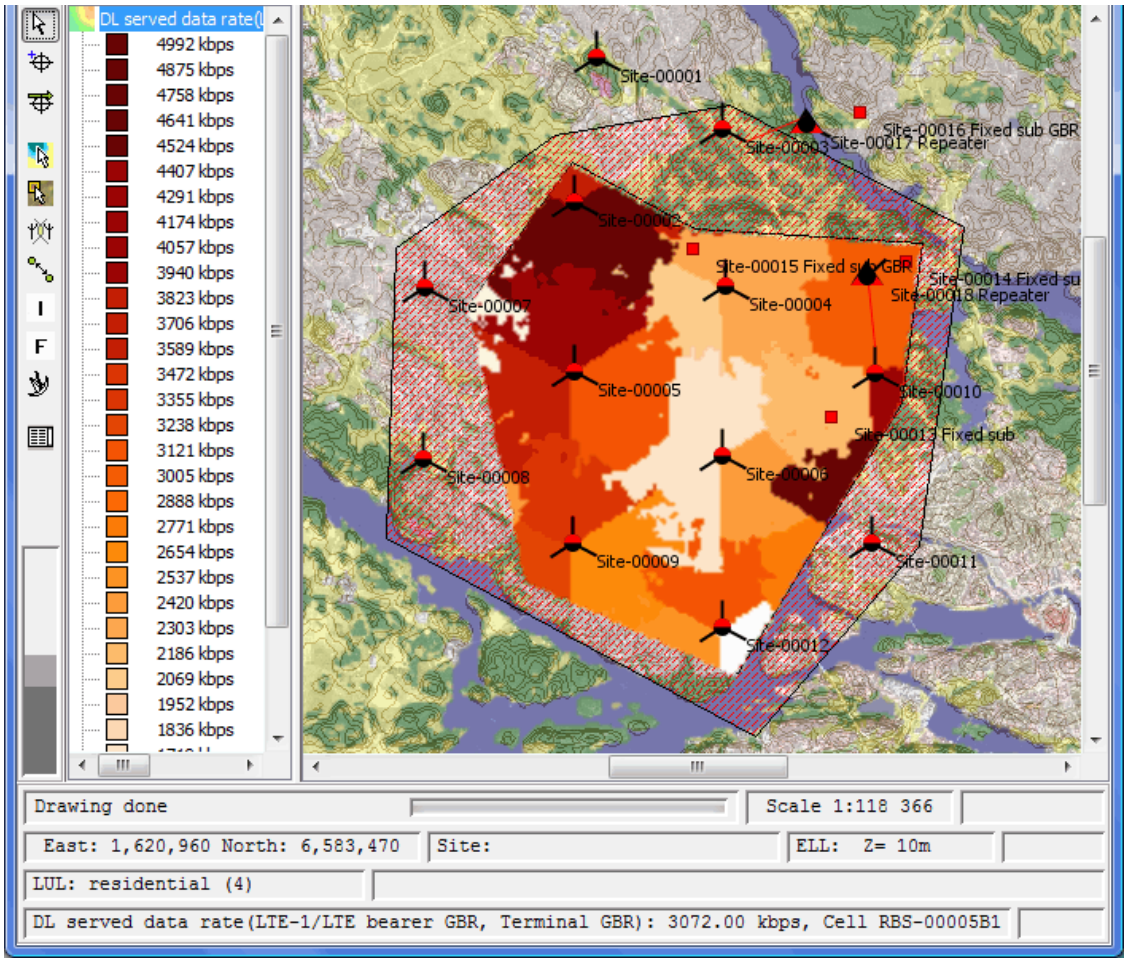
(Average) DL Served Data Rate

This plot displays for each cell the average downlink served data rate in kbps, that is, the sum of served DL data rates for all terminals connected to the cell, for the selected carrier frequency and per traffic case. The value is plotted in all bins belonging to the best server area of each cell.

In detail, this plot shows the average data rate over time while the plot (Instantaneous) DL Data Rate (with Interference) shows the data rate given to users at connection establishment. The values in this plot are limited by the average requested data rate while the values in plot (Instantaneous) DL Data Rate (with Interference) may exceed the average requested data rate.

The served DL data rate is displayed on the status bar with the identity of the best serving cell, the carrier frequency, and the bearer and terminal of the traffic case.

The figure below exemplifies a DL served data rate plot:



You can also generate an LTE Analysis Report showing the average served DL data rate per traffic case and cell.

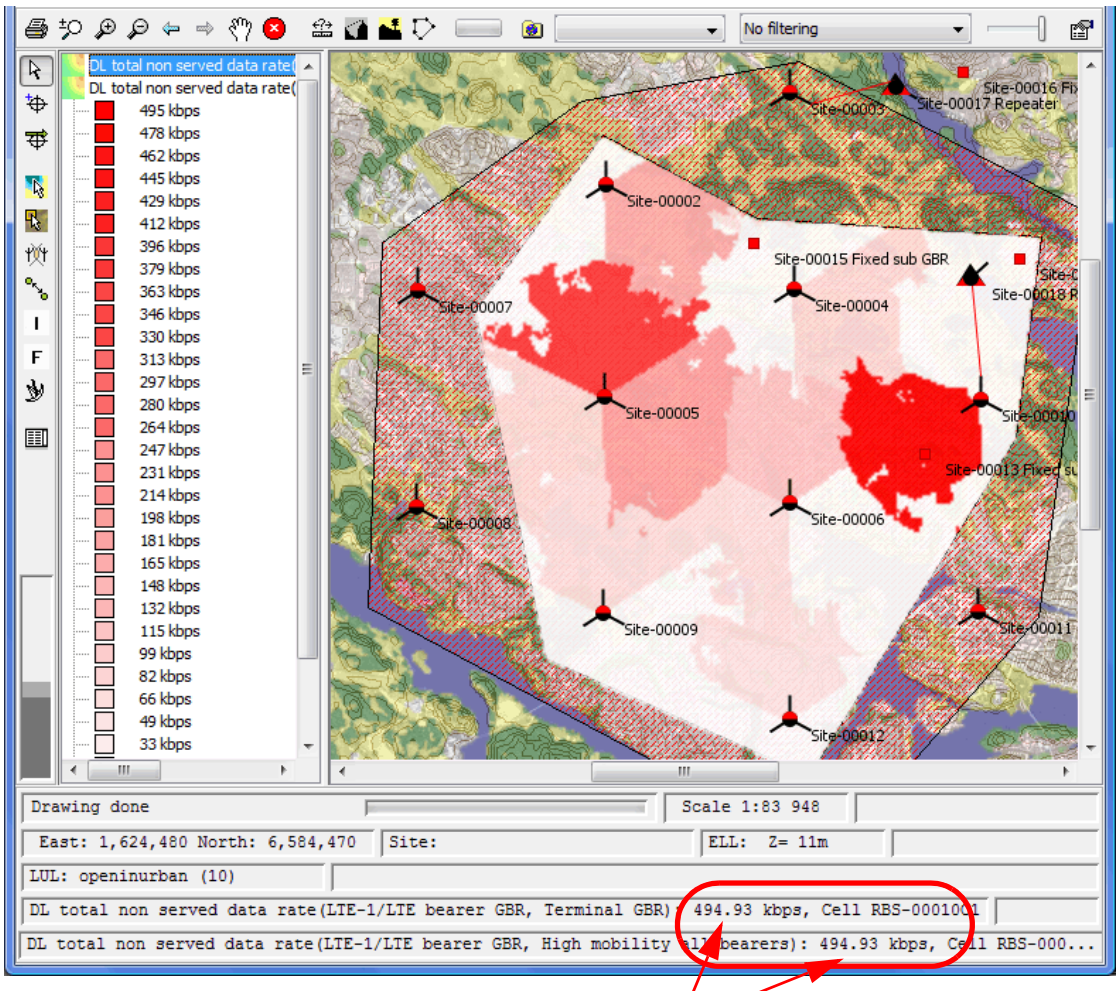
(Average) DL Total Non Served Data Rate

This plot displays for each cell the average downlink cell capacity that is not consumed in the cell, for the selected carrier frequency and summed over all traffic cases. The value is plotted in all bins belonging to the best server area of each cell.

The total not served DL data rate is displayed on the status bar together with the identity of the best serving cell.

The various reasons for blocking (not serving) users are described in the *TEMS CellPlanner LTE Technical Reference Manual*.

The figure below exemplifies a DL total non served data rate plot:



Note: Different entries are displayed per traffic case, but the same total value is shown in both cases

You can also generate an LTE Analysis Report showing the average DL not served data rate per traffic case and cell.

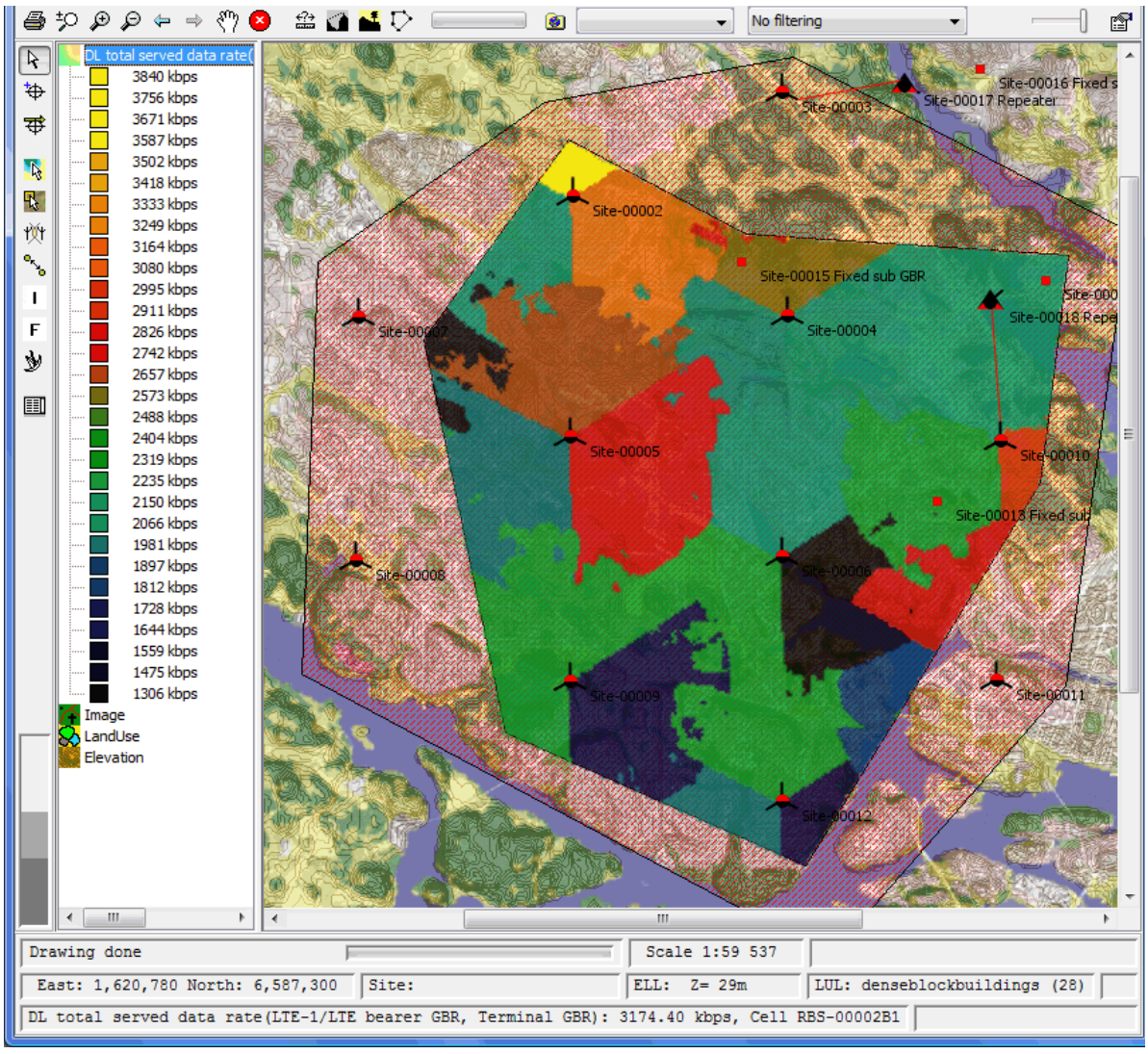
(Average) DL Total Served Data Rate

This plot displays for each cell the average downlink served data rate in kbps, that is, the sum of served DL data rates for all terminals connected to the cell, for the selected carrier frequency, summed over all traffic cases. The value is plotted in all bins belonging to the best server area of each cell.

See corresponding plot per traffic case, (Average) DL Served Data Rate.

The total served DL data rate is displayed on the status bar together with the identity of the best serving cell.

The figure below exemplifies a DL total served data rate plot:



You can also generate an LTE Analysis Report showing the average DL served data rate per traffic case and cell.

DL Transmission Scheme

This plot displays for each bin the best (or only) possible transmit scheme and the corresponding transmission rank with the current cell configuration, for the selected carrier frequency and traffic case.

Transmit Scheme

Transmit schemes is an alternative naming of Tx antenna configurations.

Each transmit scheme corresponds to a DL Suggested LTE Terminal Types, where the bit rate per terminal type is retrieved.

The possible transmit schemes are:

- 1x2 MRC
- 2x2 Tx diversity
- 2x3 MIMO

Rank

The *rank* is the number of DL bit streams.

Rank 2 gives a doubled maximum bit rate but also requires a higher C/(I+N).

The possible ranks are:

- 1 (one) for 1x2 MRC
- 1 (one) for 2x2 Tx diversity (the same bit stream is sent via two antennas)
- 2 (two) for 2x2 MIMO (separated bit streams are sent via the two antennas)

Best Possible Transmit Scheme and Rank

The *best possible transmit scheme and rank* is calculated for each bin, considering the best server in the cell, its Tx antenna configuration, and its maximum DL data rate to a terminal type of the analyzed traffic case.

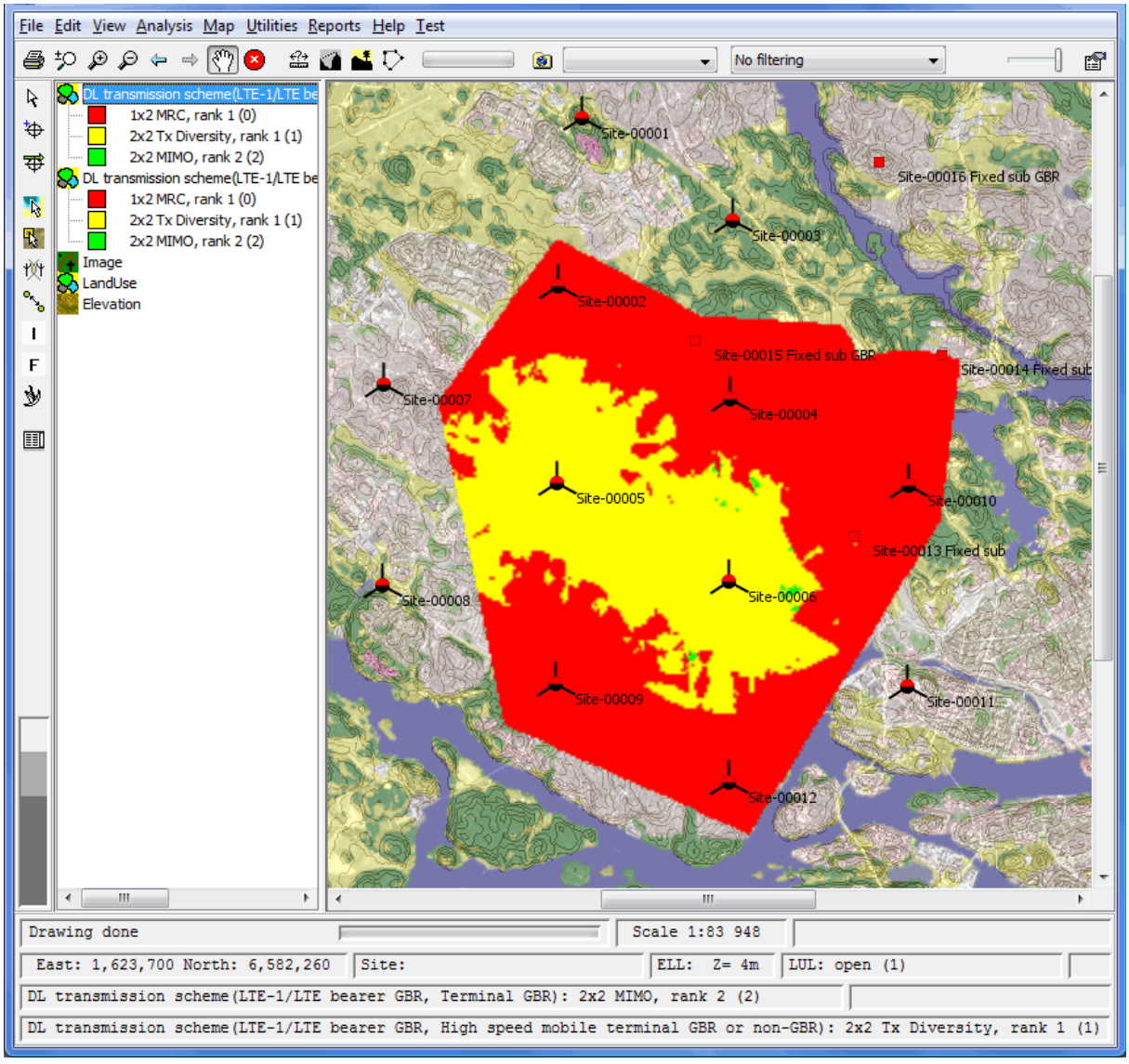
The best (or only) possible transmit scheme is displayed on the status bar together with the carrier frequency, the bearer and terminal of the traffic case, and the identity of the best serving cell. The possible values reflect the setting of parameter **Transmission scheme**, see Configure LTE Cell Analysis Parameters on page 9-13.

The resulting best (or only possible) scheme and rank per bin is one of the following:

- **1x2 MRC, rank 1** where the best serving cell has one Tx antenna
- **2x2 tx diversity, rank 1** where:
  - the best serving cell has two Tx antennas but MIMO is not supported
  - the best serving cell supports 2x2 Tx diversity and 2x2 MIMO, but 2x2 Tx diversity gives the highest bit rate
- **2x2 MIMO, rank 2** where the best serving cell supports 2x2 MIMO (and 2x2 Tx diversity), but 2x2 MIMO gives the highest bit rate

The figure below shows an example of a DL transmission scheme plot with results from analysis of two traffic cases. When placing the cursor over the given position, the status bar shows that 2x2 MIMO yields the highest bit rate in one case, and 2x2 Tx diversity is best in the other case.

Note that the data rate in case of using MIMO (or 2x2 Tx diversity) in a cell is calculated only if the cell is configured as MIMO (or 2x2 Tx diversity) capable:



DL Utilization

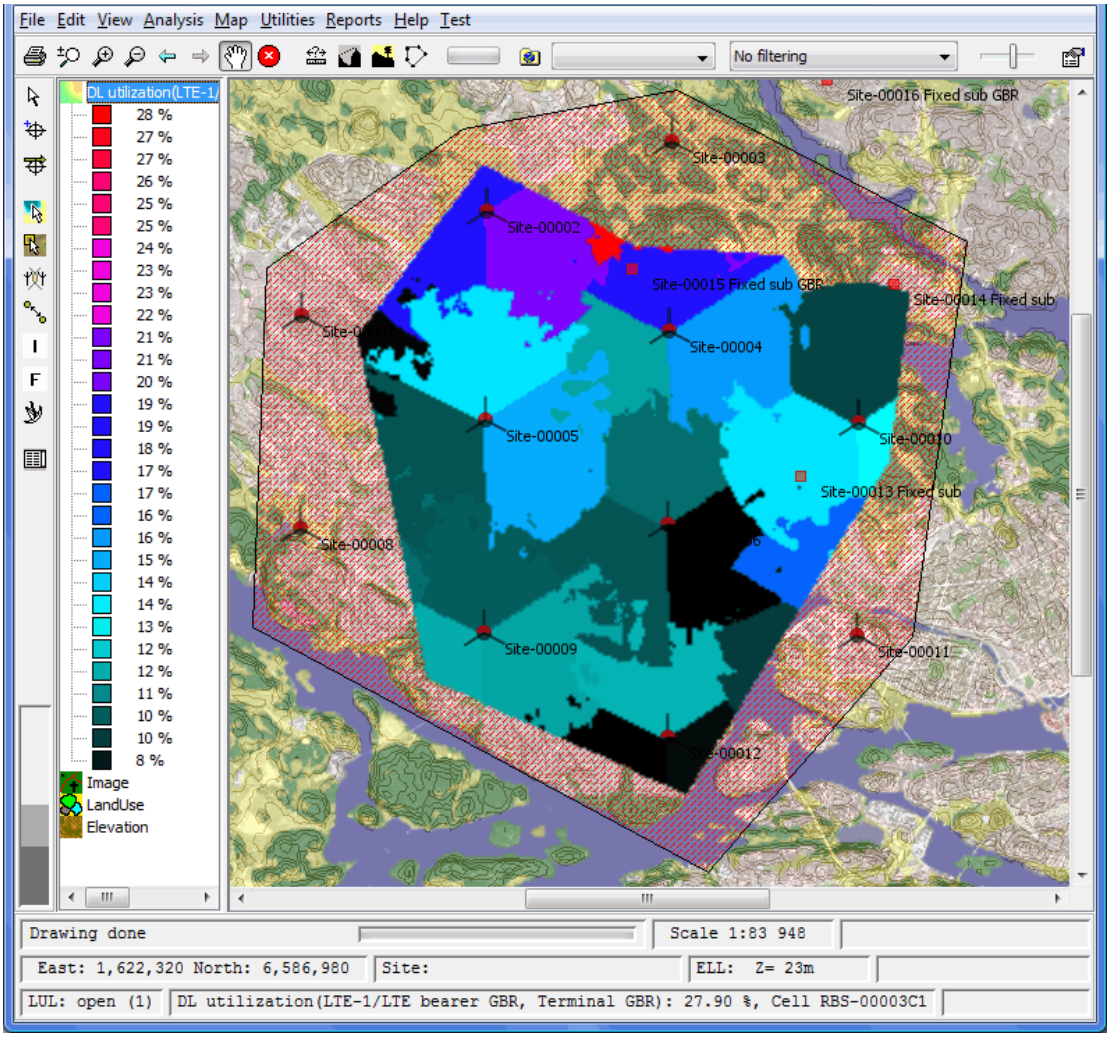
This plot displays for each cell the used percentage of the downlink capacity of the serving cell for the selected carrier frequency, summed over all traffic cases.

100% utilization of a cell's downlink capacity is reached when all downlink RBs are used all the time. A utilization value >100% indicates that the DL capacity is too low.

The obtained DL utilization value is automatically fed back to the cell parameter **DL load**, see Configure LTE Cell Analysis Parameters.

The DL utilization is displayed on the status bar, together with the identity of the serving cell.

The figure below shows an example of a DL utilization plot:



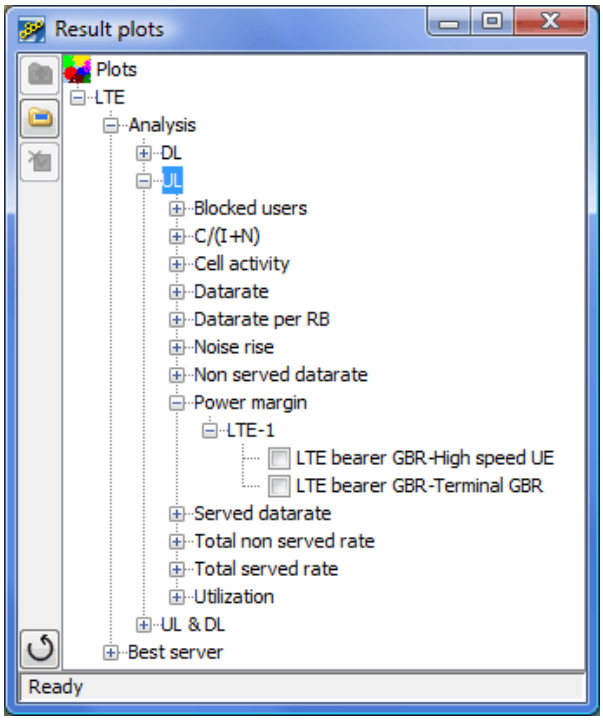
You can also generate an LTE Analysis Report showing the DL utilization per cell.

LTE Analysis Plots for Uplink

The subsequent pages describe and exemplify available uplink LTE Analysis Plots, generated for the selected carrier frequency and each traffic case of the selected traffic demand mix:

- Users Blocked in UL
- UL C/(I+N)
- UL Cell Activity - summed over all traffic cases
- (Instantaneous) UL Data Rate (with Interference)
- (Instantaneous) UL Data Rate per RB (with Interference)
- UL Noise Rise - summed over all traffic cases
- (Average) UL Non Served Data Rate
- UL Power Margin
- (Average) UL Served Data Rate
- (Average) UL Total Non Served Data Rate - summed over all traffic cases
- (Average) UL Total Served Data Rate - summed over all traffic cases
- UL Utilization - summed over all traffic cases

The result plots window opened from **Analysis↗Result plots** including uplink LTE analysis plots might look as in the following example:



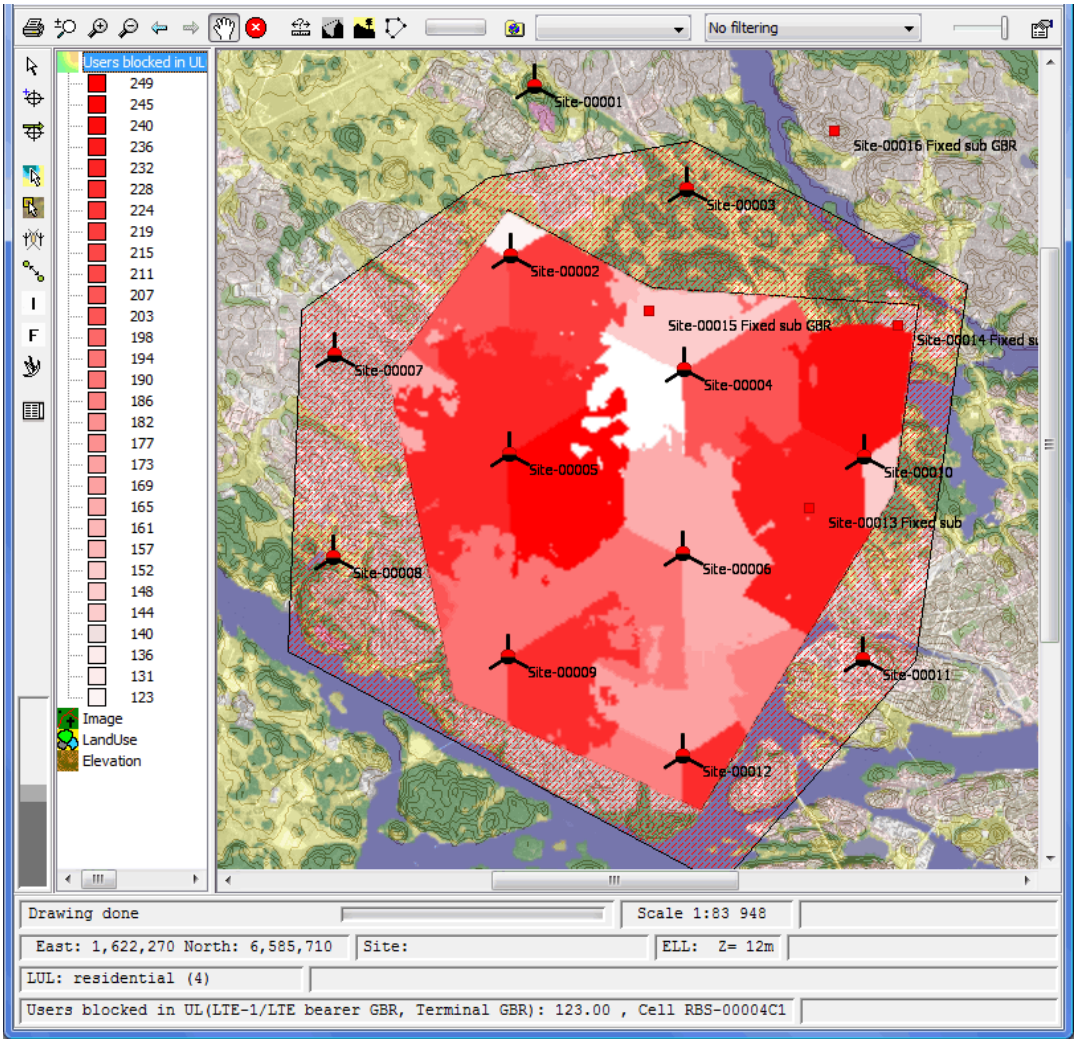
Users Blocked in UL

This plot displays for each cell the average number of non-served users in uplink, for the selected carrier frequency and traffic case. The value is plotted in all bins belonging to the best server area of each cell.

The status bar displays the number of blocked (not served) users together with the traffic case and the identity of the best serving cell.

The various reasons for blocking (not serving) users are described in the *TEMS CellPlanner LTE Technical Reference Manual*.

The figure below exemplifies a plot showing number of users blocked in uplink in a highly loaded network:



You can also generate an LTE Analysis Report showing the average number of blocked (not served) users per traffic case and cell. Statistics are available for any or specific blocking reasons.

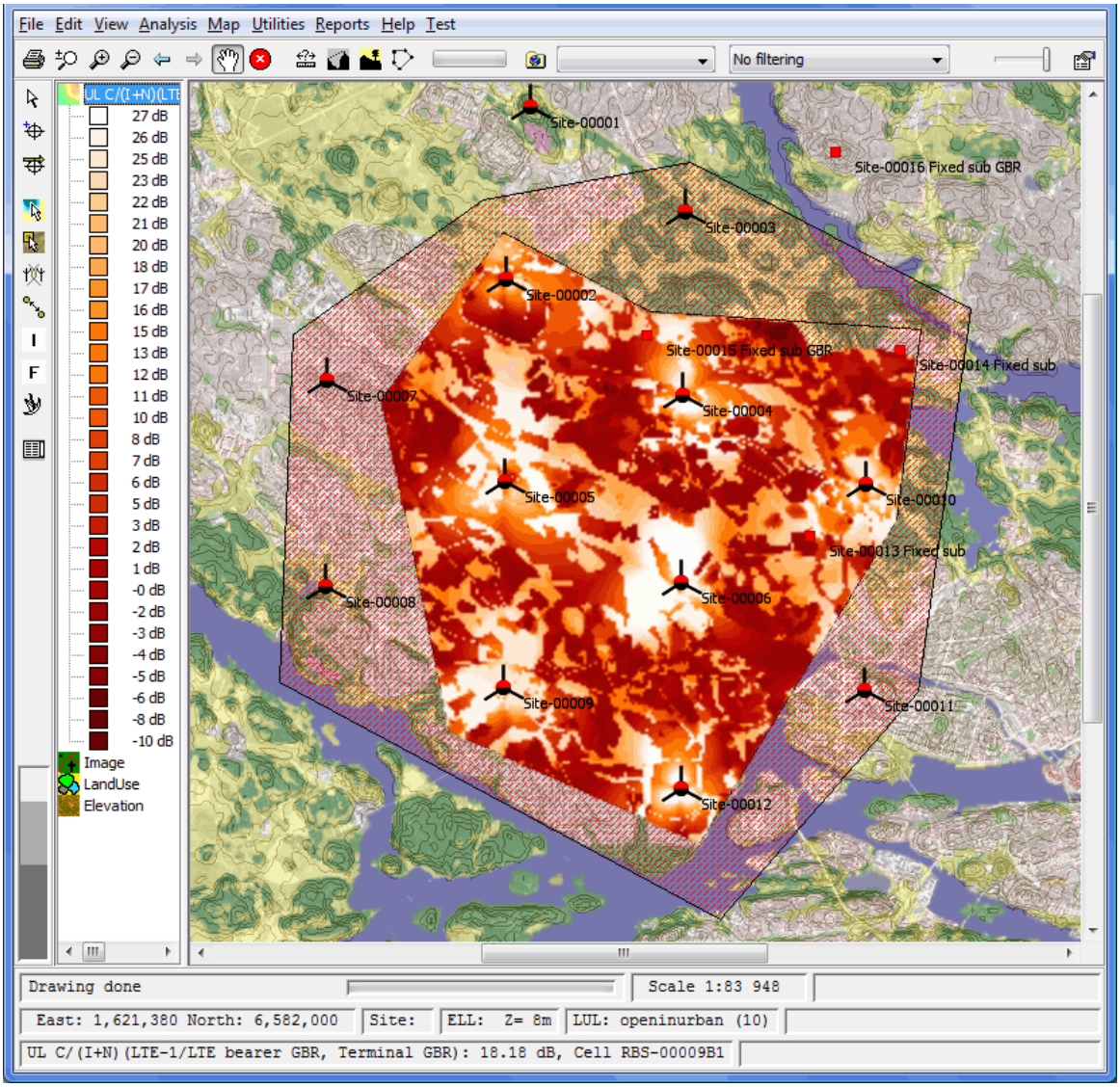
UL C/(I+N)

This plot displays for each bin the average uplink C/(I+N) in dB, with UL power control, for the selected carrier frequency and traffic case.

The UL C/(I+N) is displayed on the status bar together with the identity of the best serving cell, the carrier frequency, and the bearer and terminal type of the traffic case.

An (Instantaneous) UL Data Rate per RB (with Interference) plot is generated together with this
UL C/(I+N) plot.

The figure below exemplifies an UL C/(I+N) plot:



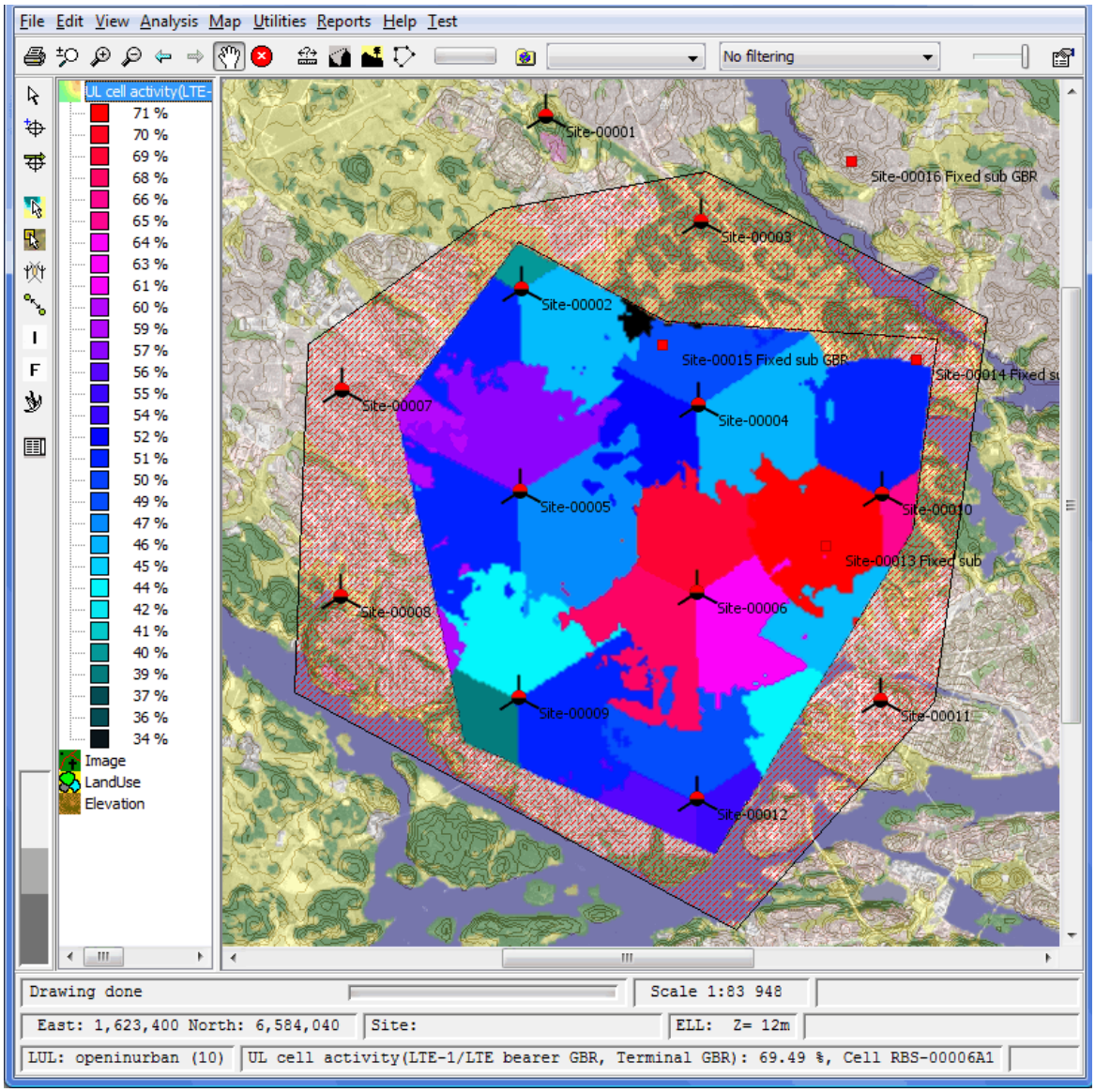
UL Cell Activity

This plot displays for each cell the average uplink activity in the cell, for the selected carrier frequency, summed over all traffic cases. The status bar displays the UL cell activity value together with the identity of the best serving cell.

An UL Utilization plot is generated together with the UL cell activity plot.

Read more about UL cell activity in section *Admission Control Parameters* in the *TEMS CellPlanner LTE Technical Reference Manual*.

The figure below exemplifies an UL cell activity plot:



You can also generate an LTE Analysis Report showing the UL activity per cell.

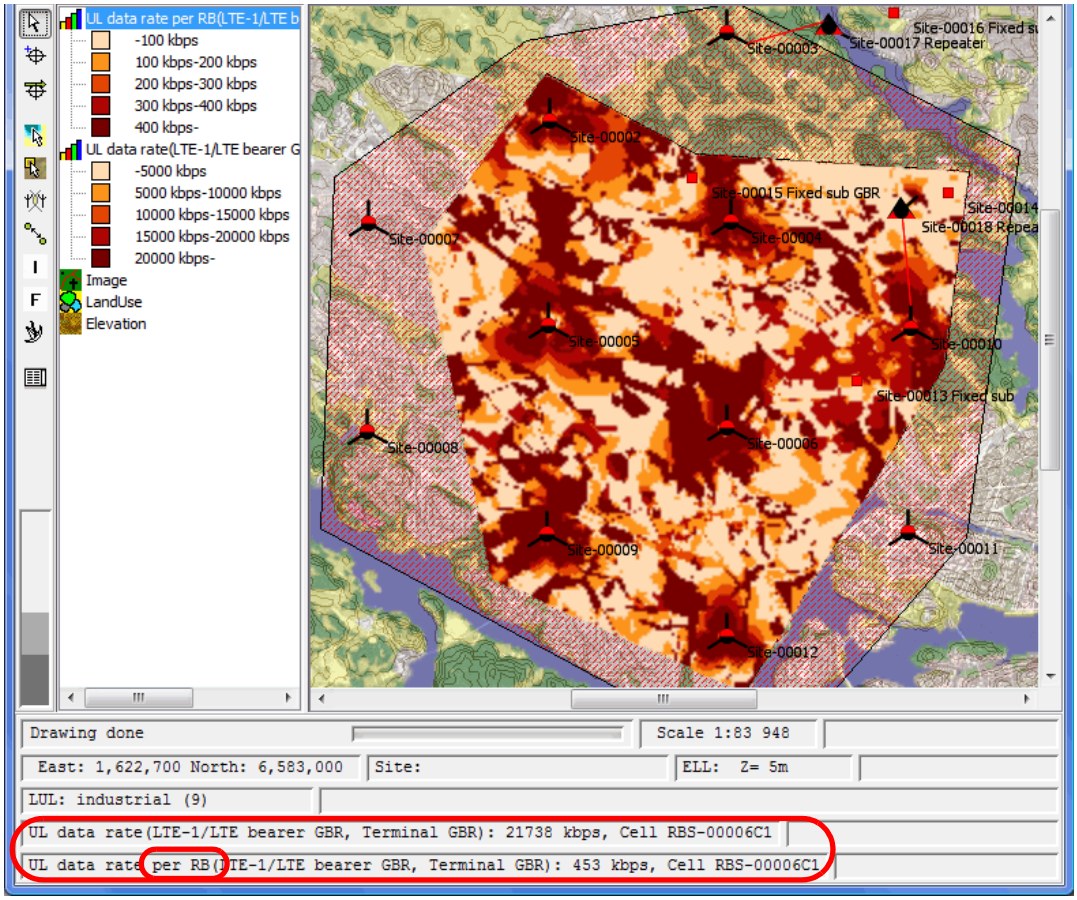
(Instantaneous) UL Data Rate (with Interference)

This plot displays for each bin the instant uplink data rate in kbps received in all resource blocks (RBs) sent on the carrier frequency for the selected traffic case, considering UL interference from surrounding users and cells. See plot UL C/(I+N). The UL data rate of the whole carrier is calculated by multiplying the (Instantaneous) UL Data Rate per RB (with Interference) with the number of RBs set in the LTE Carrier Mappings.

This plot shows the data rate given to users at connection establishment, while the plot (Average) UL Served Data Rate shows the average data rate over time. The data rate values in this plot may exceed the average requested data rate, while the values in plot (Average) UL Served Data Rate are limited by the average requested data rate.

The UL data rate with interference is displayed on the status bar together with the identity of the serving cell, the carrier frequency, and the bearer and terminal type of the traffic case.

In the example below the plots (Instantaneous) UL Data Rate (with Interference) and (Instantaneous) UL Data Rate per RB (with Interference) are displayed simultaneously



You can also generate an LTE Analysis Report showing the average achieved UL data rate per traffic case and cell.

(Instantaneous) UL Data Rate per RB (with Interference)

The plot (Instantaneous) UL Data Rate per RB (with Interference) is similar to the (Instantaneous) UL Data Rate (with Interference) but it displays the data rate received in only one resource block (RB) sent on the carrier frequency for the selected traffic case.

The DL data rate per RB is retrieved from the terminal type's downlink Data Rate Mapping.

An UL C/(I+N) plot is generated together with the UL data rate per RB plot.

See example in (Instantaneous) UL Data Rate (with Interference) on page 13-33.

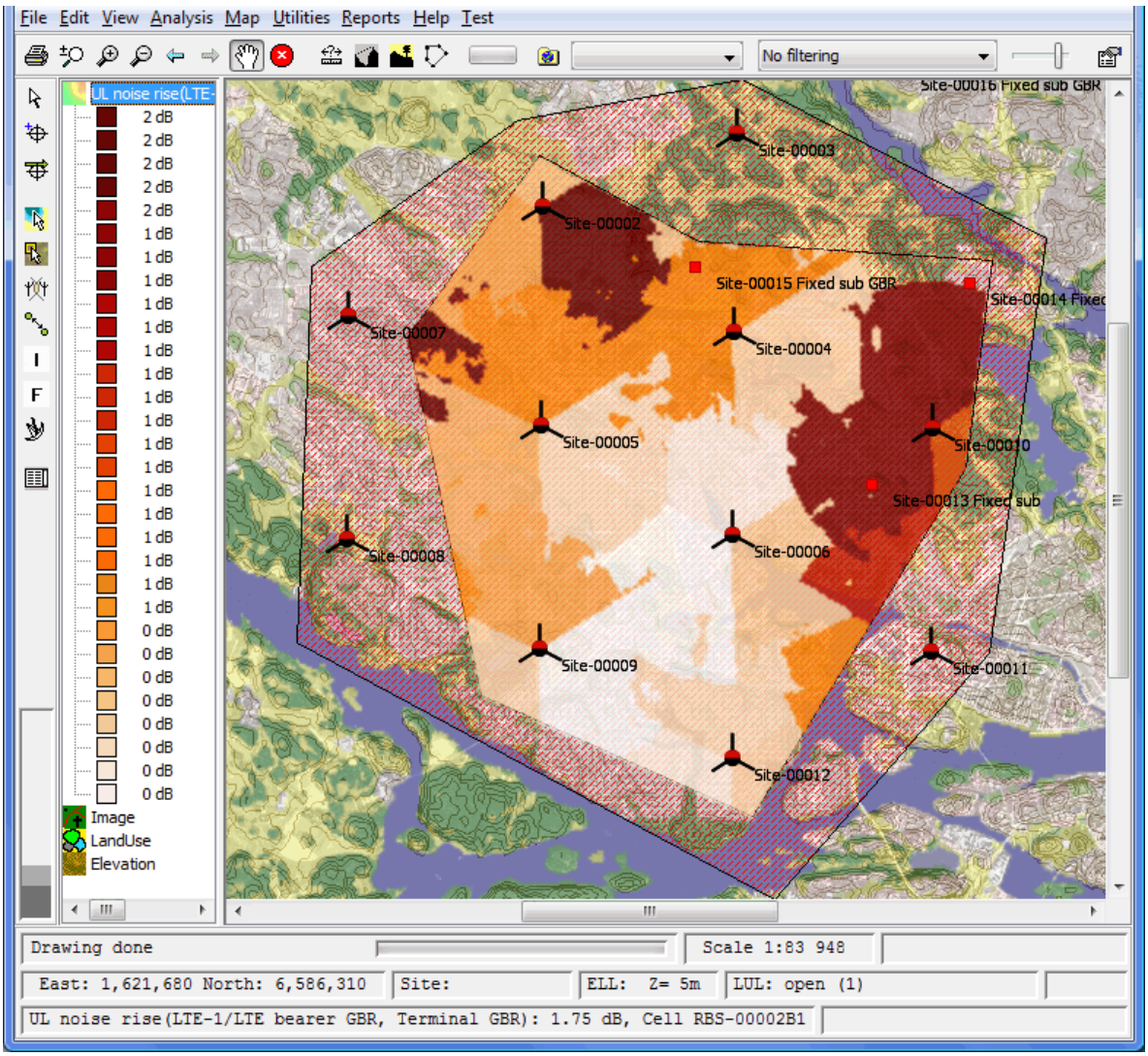
UL Noise Rise

This plot displays for each cell the average UL noise rise in dB for the selected carrier frequency, summed over all traffic cases. The noise rise value is displayed in all bins belonging to the best server area of each cell.

The UL noise rise is 10* $\log_{10}$ [(I+N)/N], where I is the average interference and N the ambient noise.

The UL noise rise is displayed on the status bar together with the identity of the best serving cell.

The figure below shows an example of an uplink noise rise plot:



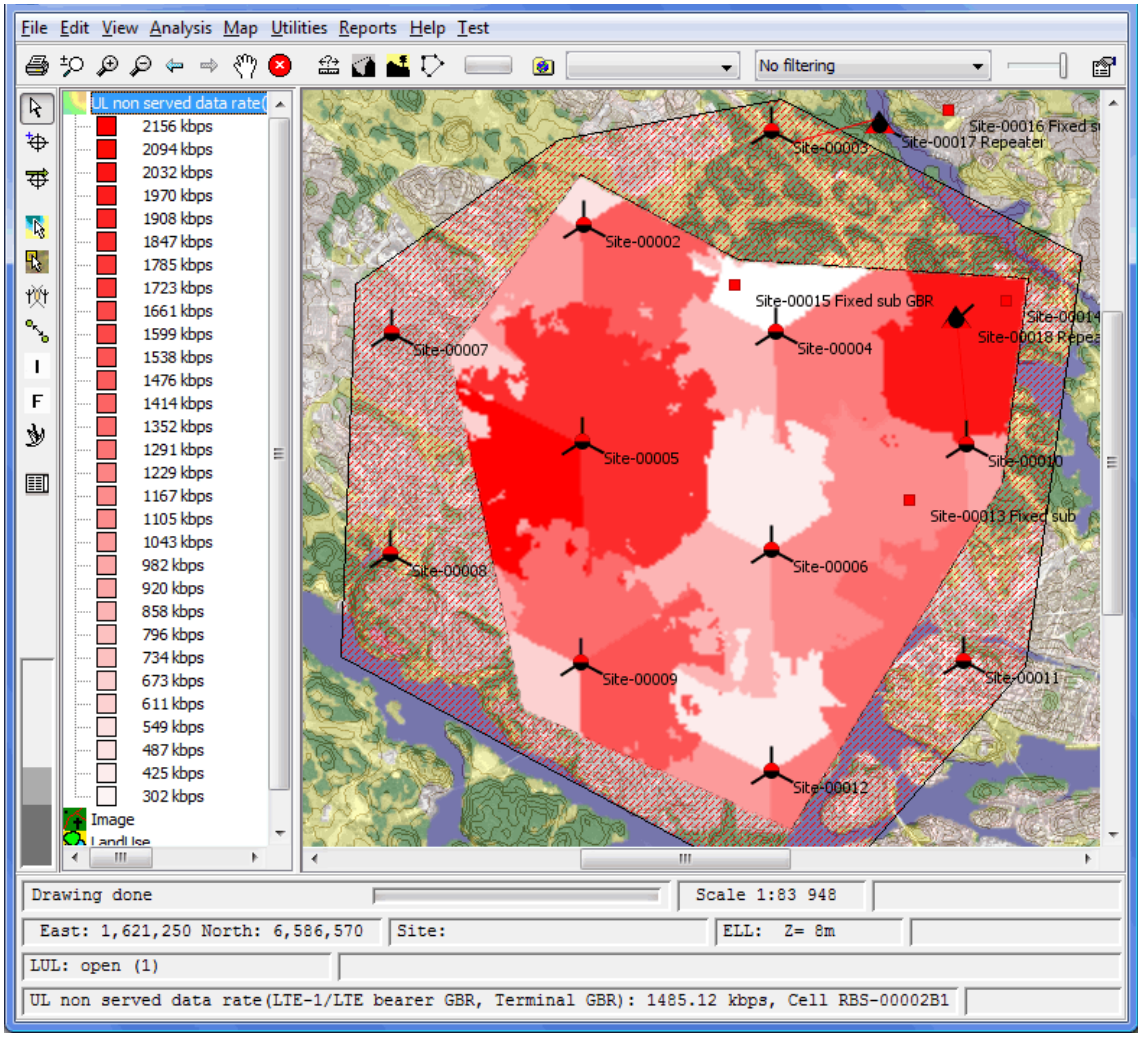
(Average) UL Non Served Data Rate

This plot displays for each cell the average uplink cell capacity that is not consumed in the cell, for the selected carrier frequency and per traffic case. The value is plotted in all bins belonging to the best server area of each cell.

The not served UL data rate is displayed on the status bar together with the identity of the best serving cell, the carrier frequency, and the bearer and terminal of the traffic case.

The various reasons for blocking (not serving) users are described in the *TEMS CellPlanner LTE Technical Reference Manual*.

The figure below shows a not served UL data rate plot:



You can also generate an LTE Analysis Report showing the average not served data rate per traffic case and cell.

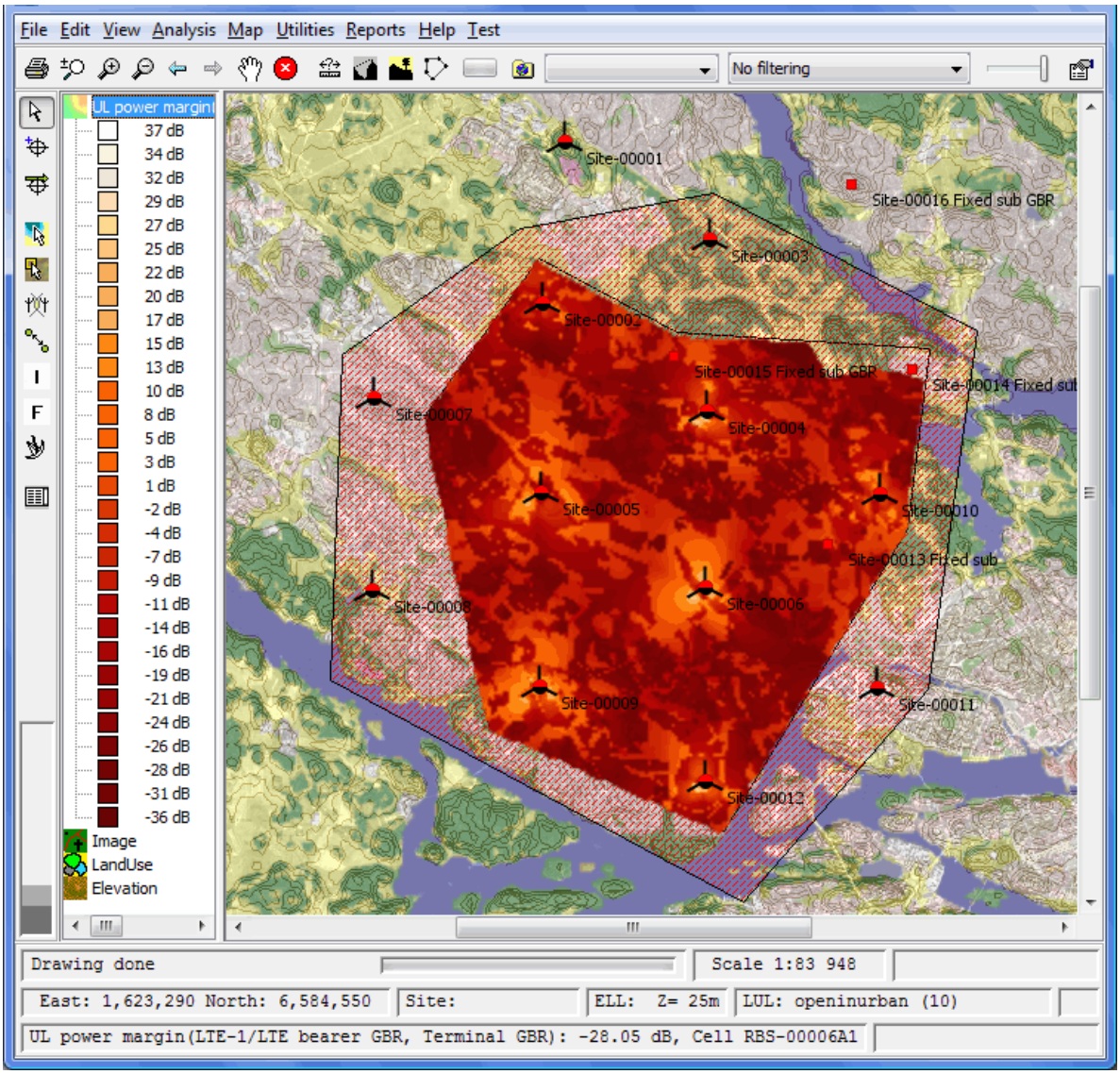
UL Power Margin

This plot displays for each bin the margin in dB to the user-defined target C/(I+N) or UL data rate for the selected carrier frequency and traffic case.

The status bar displays the power margin together with the identity of the best serving cell, the carrier frequency, and the bearer and terminal of the traffic case.

A negative power margin means that the terminal cannot reach the user-defined target data rate or C/(I+N), but it can still reach a lower data rate or C/(I+N).

The figure below exemplifies an UL power margin plot:



You can also generate an LTE Analysis Report showing the UL power margin per fixed subscriber.

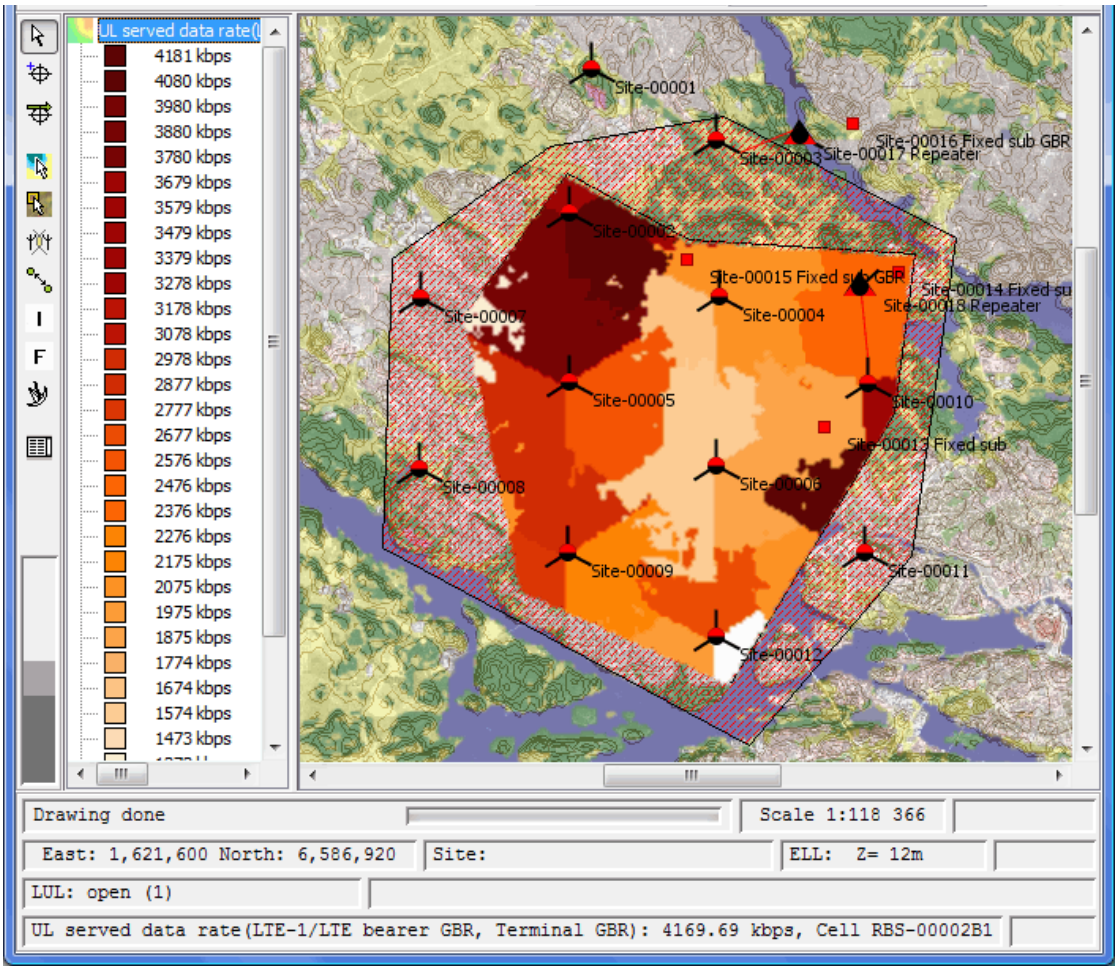
(Average) UL Served Data Rate

This plot displays for each cell the average uplink served data rate in kbps, that is, the sum of served UL data rates for all terminals connected to the cell, for the selected carrier frequency and per traffic case. The value is plotted in all bins belonging to the best server area of each cell.

In detail, this plot shows the average data rate over time while the plot (Instantaneous) UL Data Rate (with Interference) shows the data rate given to users at connection establishment. The values in this plot are limited by the average requested data rate while the values in plot (Instantaneous) UL Data Rate (with Interference) may exceed the average requested data rate.

The served UL data rate is displayed on the status bar with the identity of the best serving cell, the carrier frequency, and the bearer and terminal of the traffic case.

The figure below exemplifies an UL served data rate plot:



You can also generate an LTE Analysis Report showing the average served DL data rate per traffic case and cell.

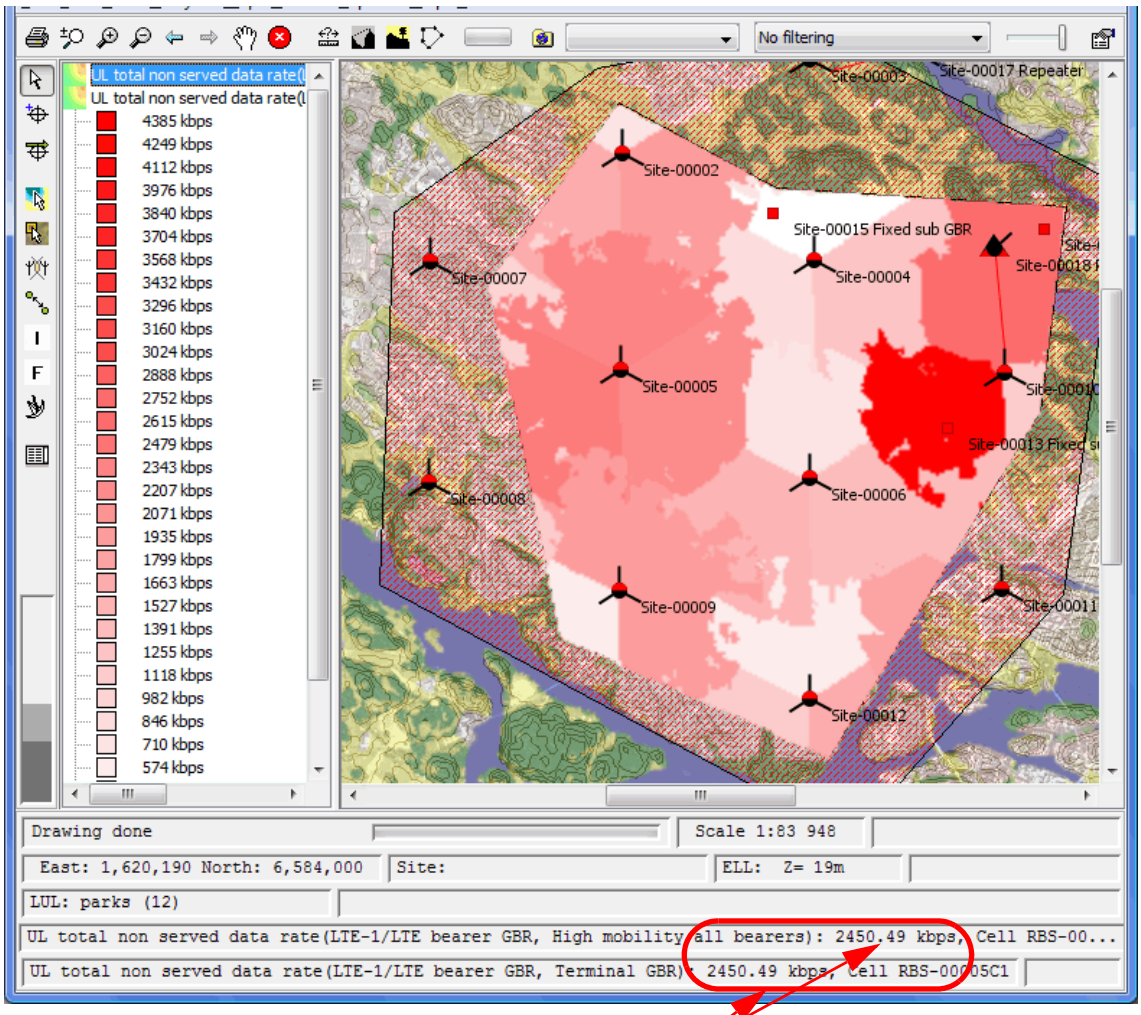
(Average) UL Total Non Served Data Rate

This plot displays for each cell the average uplink cell capacity that is not consumed in the cell, for the selected carrier frequency and summed over all traffic cases. The value is plotted in all bins belonging to the best server area of each cell.

The total not served data rate is displayed on the status bar together with the identity of the best serving cell.

The various reasons for blocking (not serving) users are described in the *TEMS CellPlanner LTE Technical Reference Manual*.

The figure below exemplifies an UL total not served data rate plot:



Note: Different entries are displayed per traffic case, but the same total value is shown in both cases

You can also generate an LTE Analysis Report showing the average UL not served data rate per traffic case and cell.

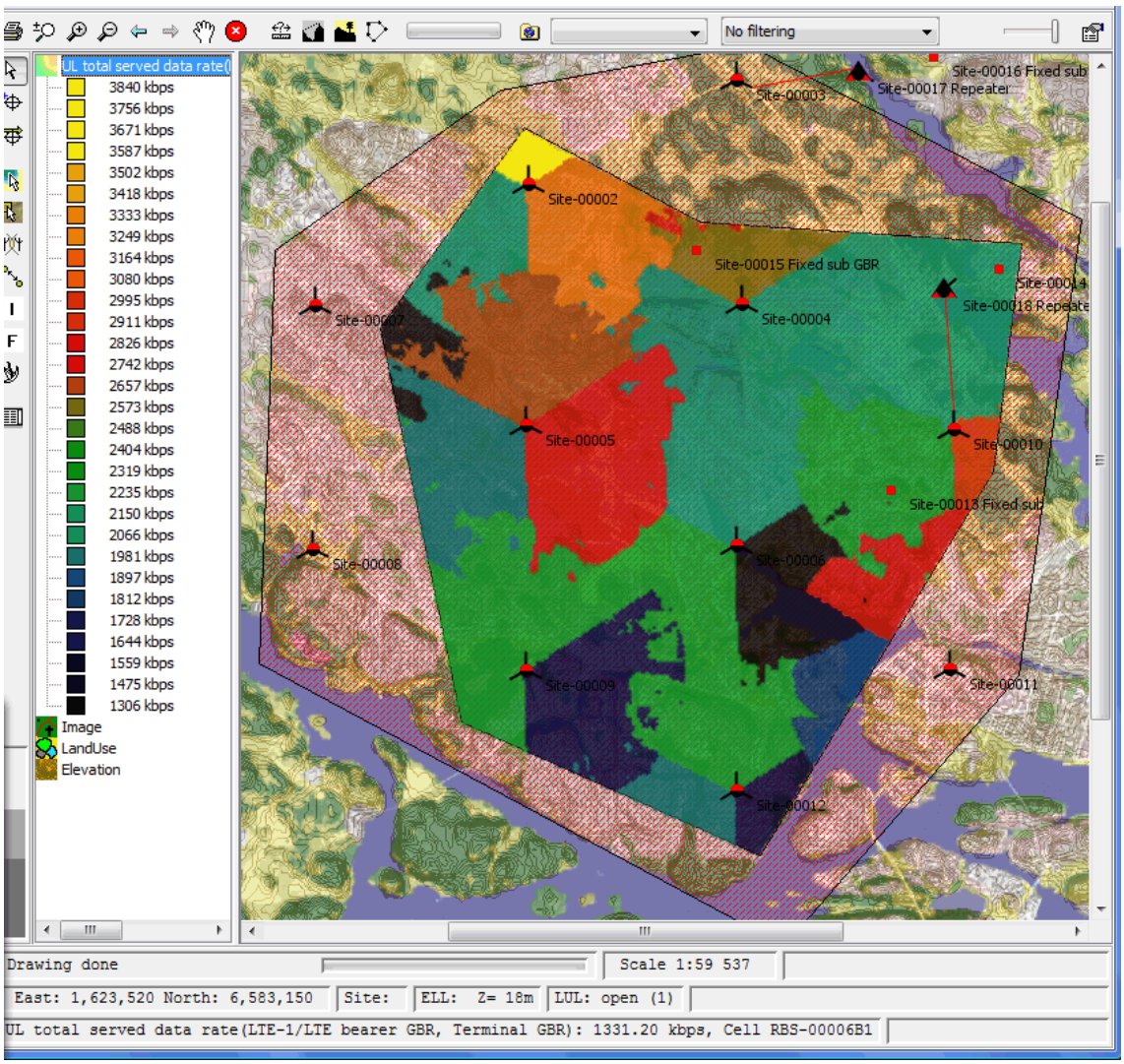
(Average) UL Total Served Data Rate

This plot displays for each cell the average downlink served data rate in kbps, that is, the sum of served DL data rates for all terminals connected to the cell, for the selected carrier frequency, summed over all traffic cases. The value is plotted in all bins belonging to the best server area of each cell.

See corresponding plot per traffic case, (Average) UL Served Data Rate.

The total served DL data rate is displayed on the status bar together with the identity of the best serving cell.

The figure below exemplifies an UL total served data rate plot:



You can also generate an LTE Analysis Report showing the average UL served data rate per traffic case and cell.

UL Utilization

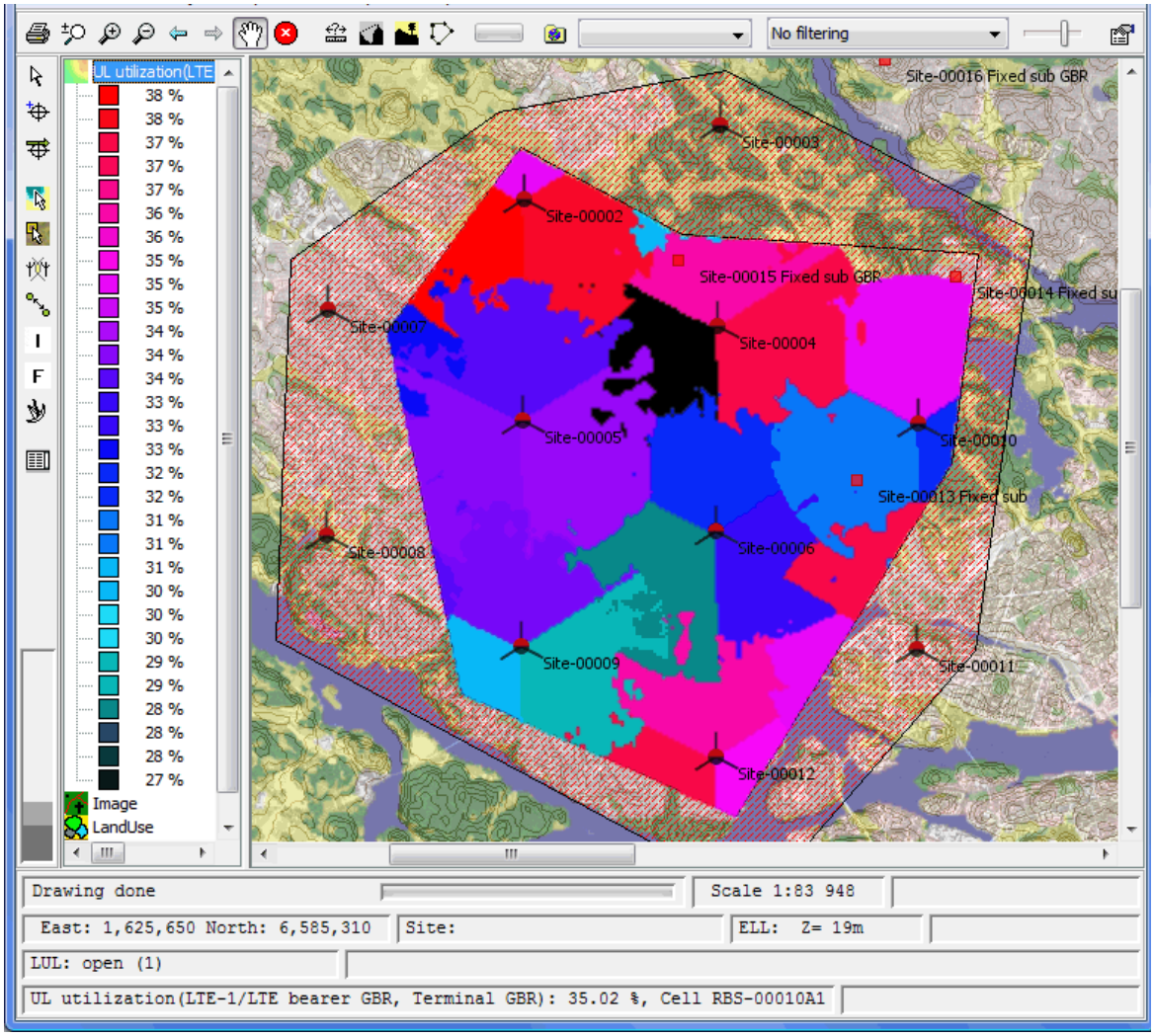
This plot displays for each cell the average UL utilization in %, for the selected carrier frequency, summed over all traffic cases. The utilization value is plotted in all bins belonging to the best server area of each cell.

100% utilization of a cell's uplink capacity is reached when all uplink RBs are used all the time. A utilization value >100% indicates that the UL capacity is too low.

The obtained UL utilization value is automatically fed back to the cell parameter **UL load**, see Configure LTE Cell Analysis Parameters.

The status bar displays the used percentage of the UL capacity of the serving cell, together with the identify of the serving cell.

The figure below shows an example of an uplink utilization plot:



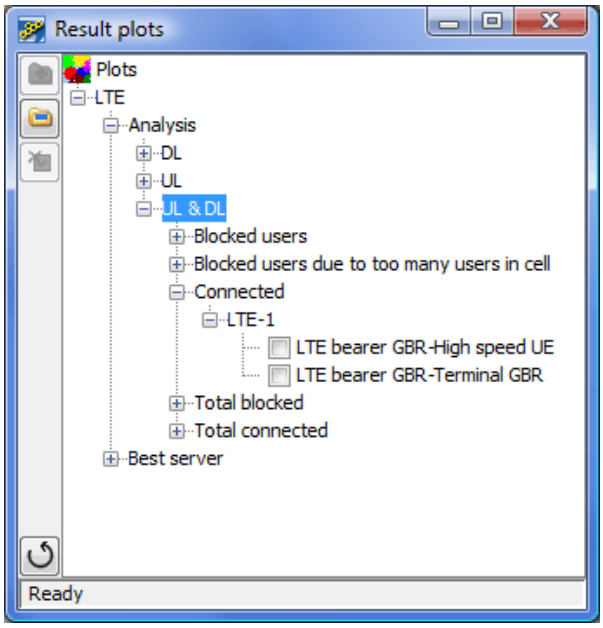
You can also generate an LTE Analysis Report showing the UL utilization per cell.

LTE Analysis Plots for Uplink & Downlink

The subsequent pages describe and exemplify available uplink and downlink LTE Analysis Plots, generated for the selected carrier frequency and each traffic case of the selected traffic demand mix:

- Users Blocked in UL & DL
- Blocked Users Due To Too Many Users
- Users Connected
- Total Blocked Users - summed over all traffic cases
- Total Connected Users. summed over all traffic cases

The result plots window opened from **Analysis↗Result plots** including UL & DL LTE analysis plots might look as in the following example:



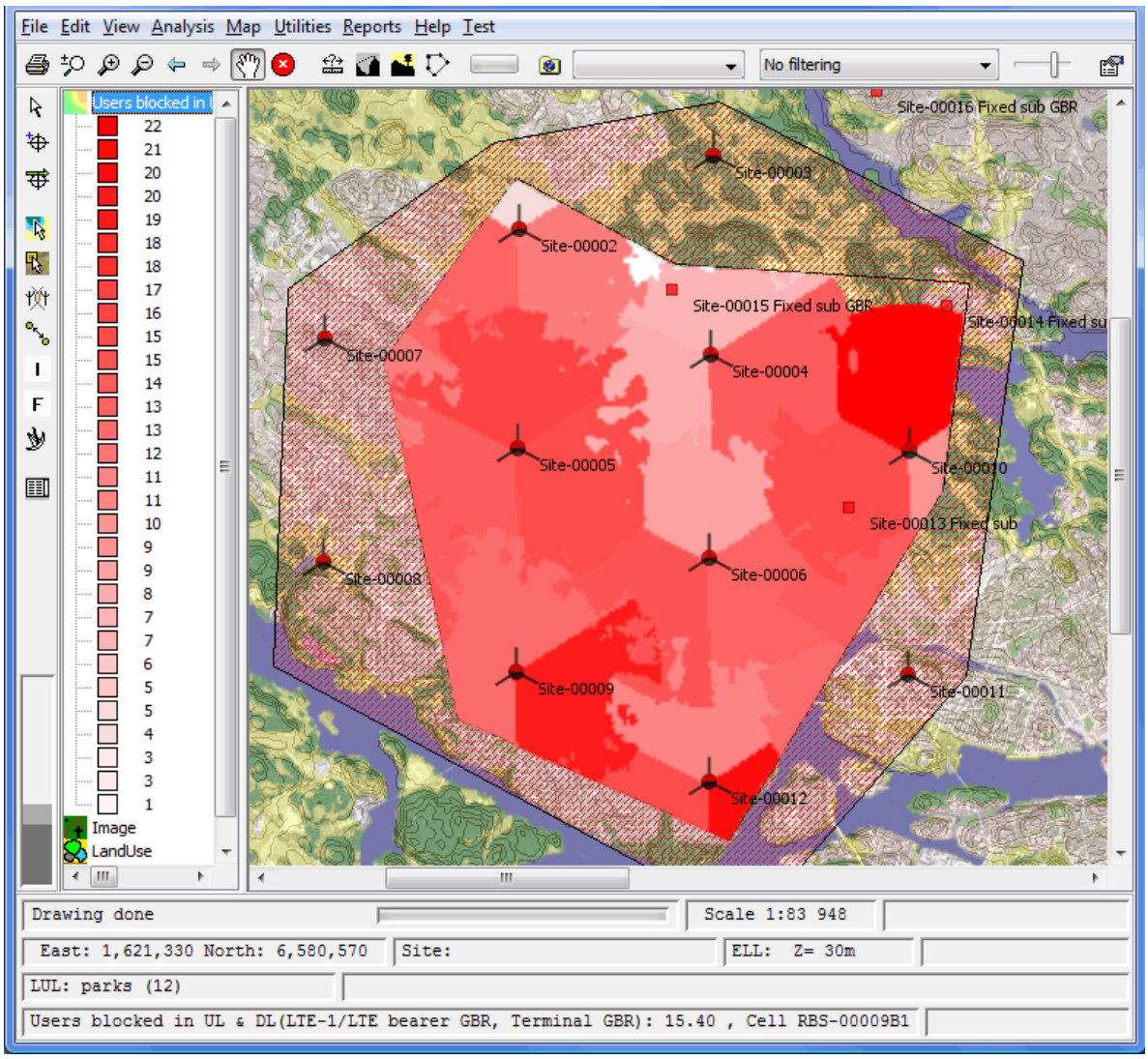
Users Blocked in UL & DL

This plot displays for each cell the sum of the average sum of blocked users in uplink and downlink, for the selected carrier frequency and traffic case. The value is plotted in all bins belonging to the best server area of each cell.

The number of blocked (not served) users is displayed on the status bar together with the identity of the best serving cell.

The various reasons for blocking (not serving) users are described in the *TEMS CellPlanner LTE Technical Reference Manual*.

The figure below exemplifies a plot showing number of blocked (not served) users:



You can also generate an LTE Analysis Report showing the number of blocked (not served) users per traffic case and cell.

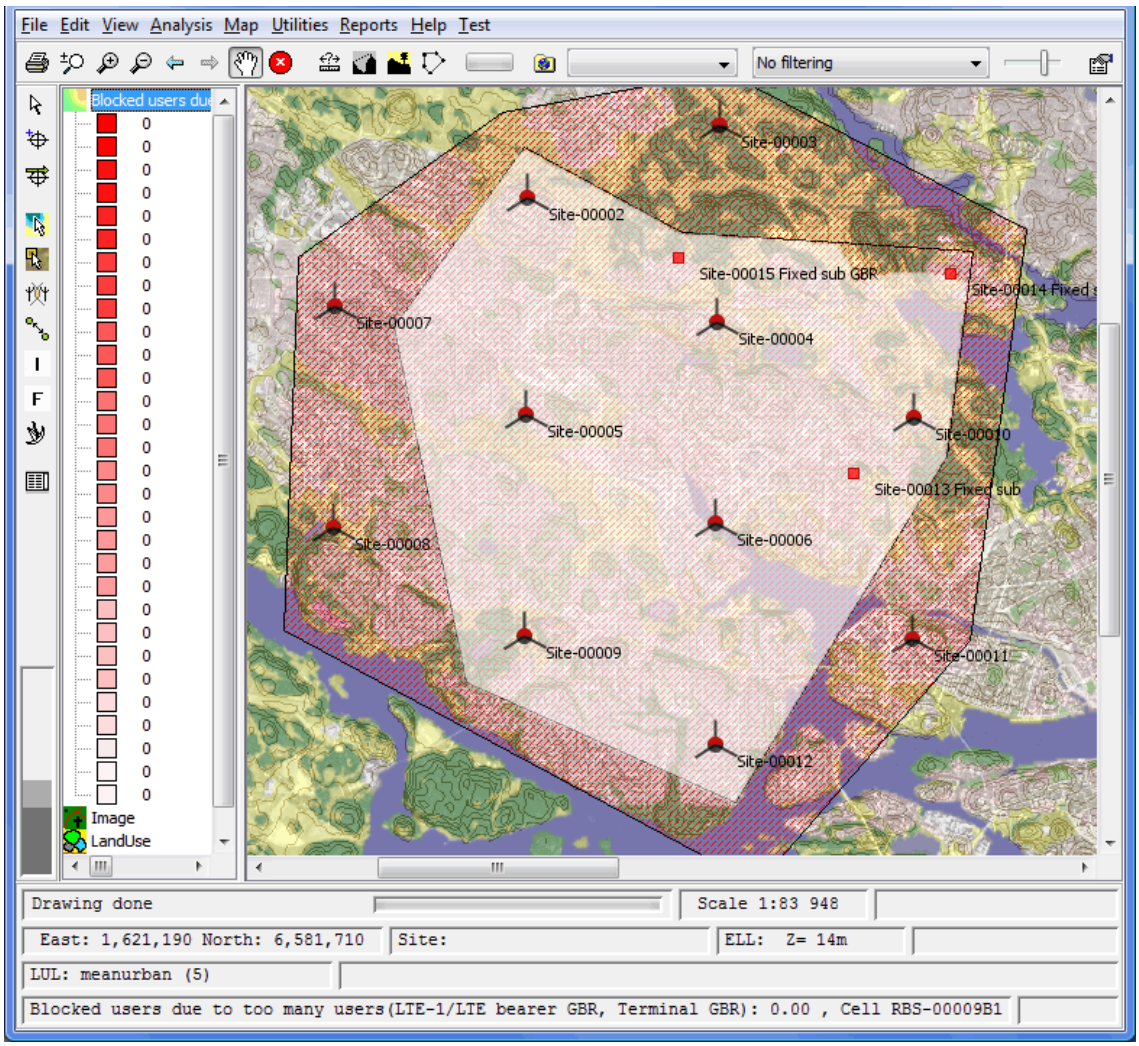
Blocked Users Due To Too Many Users

This plot displays for each cell the sum of the average sum of blocked users in uplink and downlink not admitted to connect as there are already too many users in the cell, for the selected carrier frequency and traffic case. The value is plotted in all bins belonging to the best server area of each cell.

The number of users blocked (not served) due to this reason is displayed on the status bar together with the identity of the best serving cell.

Refer to the *TEMS CellPlanner LTE Technical Reference Manual* for more details on this blocking reason.

The figure below exemplifies a plot showing the number of blocked (not served) users due to this reason:



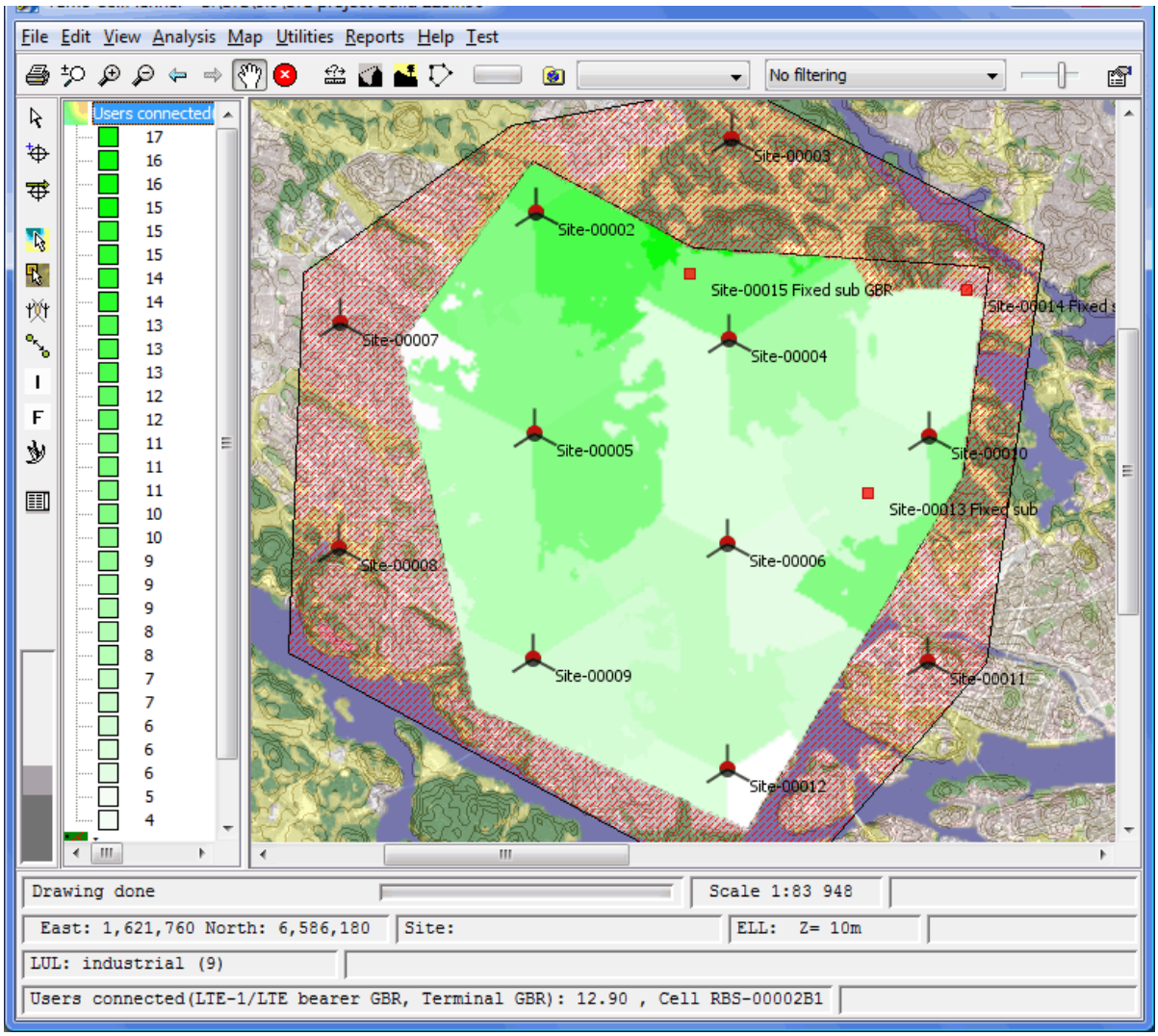
You can also generate an LTE Analysis Report per traffic case and cell, showing the number of blocked users due to this reason.

Users Connected

This plot displays for each cell the average sum of connected users in uplink and downlink, for the selected carrier frequency and traffic case. The value is plotted in all bins belonging to the best server area of each cell.

The number of connected (served) users is displayed on the status bar together with the identity of the best serving cell.

The figure below exemplifies a plot showing number of connected (served) users:



You can also generate an LTE Analysis Report per traffic case and cell, showing the number of connected (served) users.

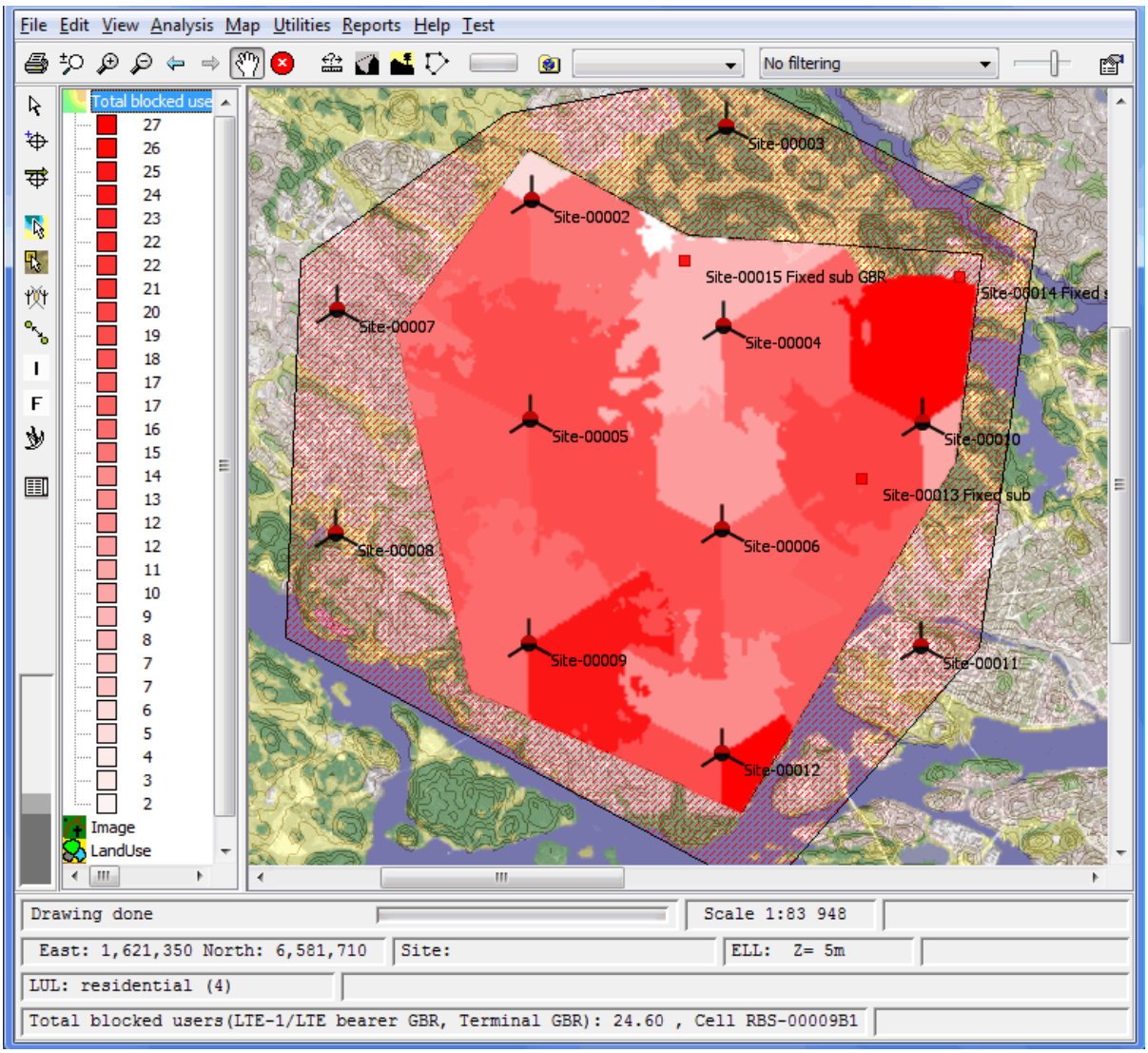
Total Blocked Users

This plot displays for each cell the sum of the average sum of blocked users in uplink and downlink, for the selected carrier frequency, summed over all traffic cases. The value is plotted in all bins belonging to the best server area of each cell.

The total number of blocked (not served) users is displayed on the status bar together with the identity of the best serving cell.

The various reasons for blocking (not serving) users are described in the *TEMS CellPlanner LTE Technical Reference Manual*.

The figure below exemplifies a plot showing total number of blocked users:



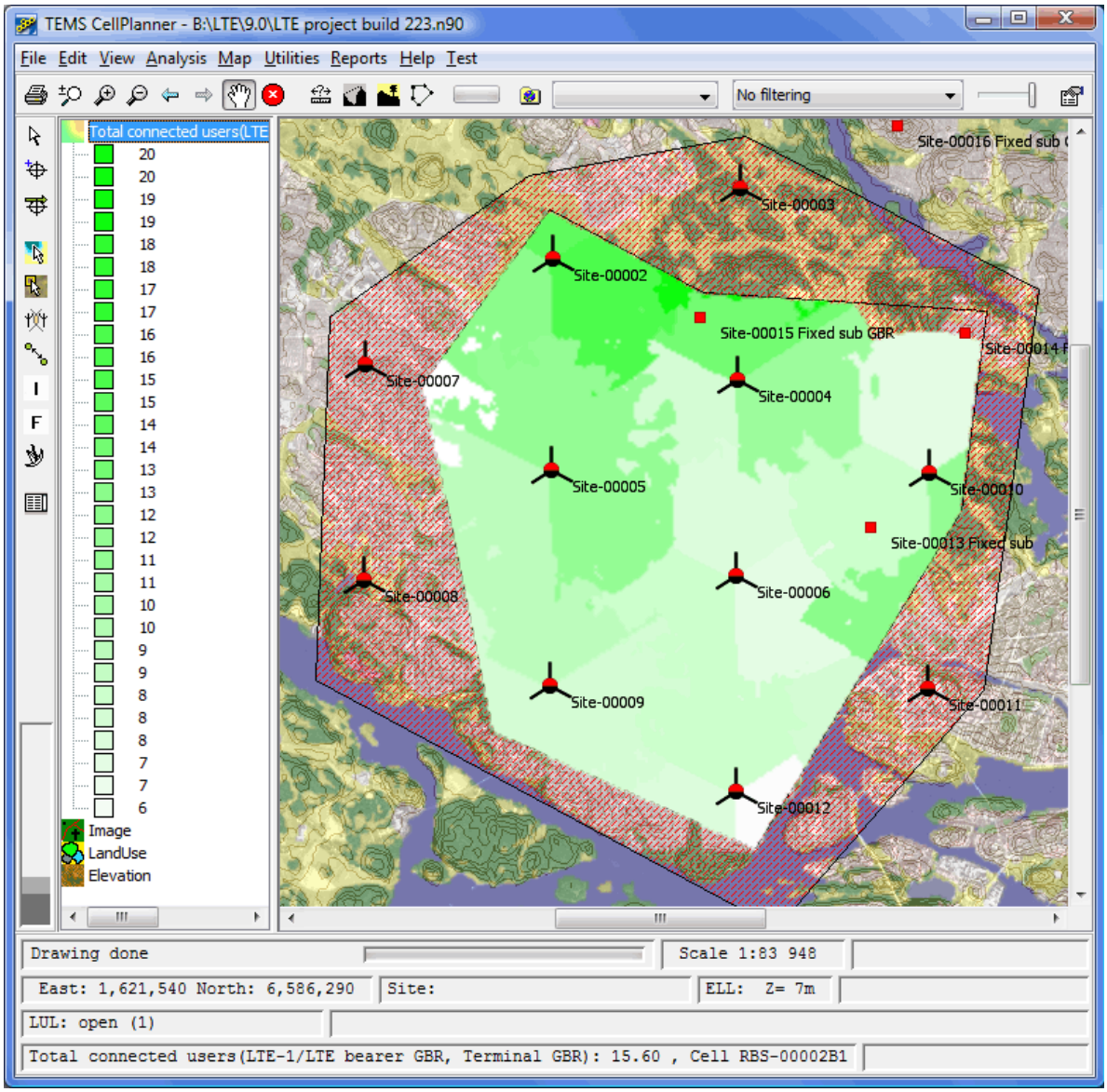
You can also generate an LTE Analysis Report showing the total number of blocked (not served) users per cell.

Total Connected Users

This plot displays for each cell the average sum of connected users in uplink and downlink, for the selected carrier frequency and traffic case, summed over all traffic cases. The value is plotted in all bins belonging to the best server area of each cell.

The total number of connected (served) users is displayed on the status bar together with the identity of the best serving cell.

The figure below exemplifies a plot showing total number of connected users:



You can also generate an LTE Analysis Report per traffic case and cell, showing the total number of connected (served) users.

14
LTE Reports

This chapter describes the format of the reports available for an LTE network plan, and how to generate the reports

Topic **Page**

LTE Analysis Report 14-2
Generate LTE Analysis Reports 14-2
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Site Installation Report. 14-15

LTE Analysis Report

After running the LTE Analysis (Including Interference) you can retrieve a set of reports in Excel or text format. The reports include statistics on data rate, number of users, number of blocked users per blocking reason, interference, utilization, and similar.

In this section you find information on how to Generate LTE Analysis Reports and the Format of LTE Analysis Reports.

See also LTE Analysis Plots on page 13-12 about statistics in graphical form.

Generate LTE Analysis Reports

You can create an LTE Analysis Report in two ways:

a. from the menu **Reports↗LTE↗Analysis...**, described in this procedure

b. from the LTE analysis wizard, see Part VI: Generate Report on page 12-27

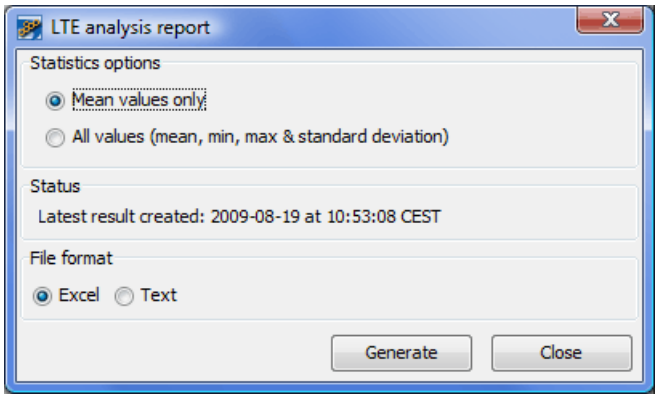
Prerequisites

Results from LTE Analysis (Including Interference) are available.

Procedure

Follow these steps to generate an LTE traffic and interference analysis report:

1. Select **Reports↗LTE↗Analysis...** The LTE analysis report dialog is displayed:



2. Select to report **Mean values only** or **All values**. The latter option will report all of mean, minimum, maximum, and standard deviation values.
3. Select the file format for the report: **Excel** or **Text**.
4. Click **Generate** to create the report. The report is opened in the selected format, see Format of LTE Analysis Reports on page 14-3.
5. Save the file.

Format of LTE Analysis Reports

When you Generate LTE Analysis Reports you obtain the following 3 to 4 reports:

- Summary
- Cell Summary, Mean Values Only, or
  Cell Summary, All Values
- Traffic Case, Mean Values Only, or
  Traffic Case, All Values - one per traffic case
- Optional: Fixed Subscribers, generated if the analysis includes fixed subscribers

Each report is either a sheet in an Excel file or a text file, depending on the selected output format.

All reports are limited to one frequency carrier and one analysis area.

The blocking reasons and parameters influencing analysis results are explained in the *TEMS CellPlanner LTE Technical Reference Manual*.

Summary

The **Summary** report shows values per traffic case, as in the following example:

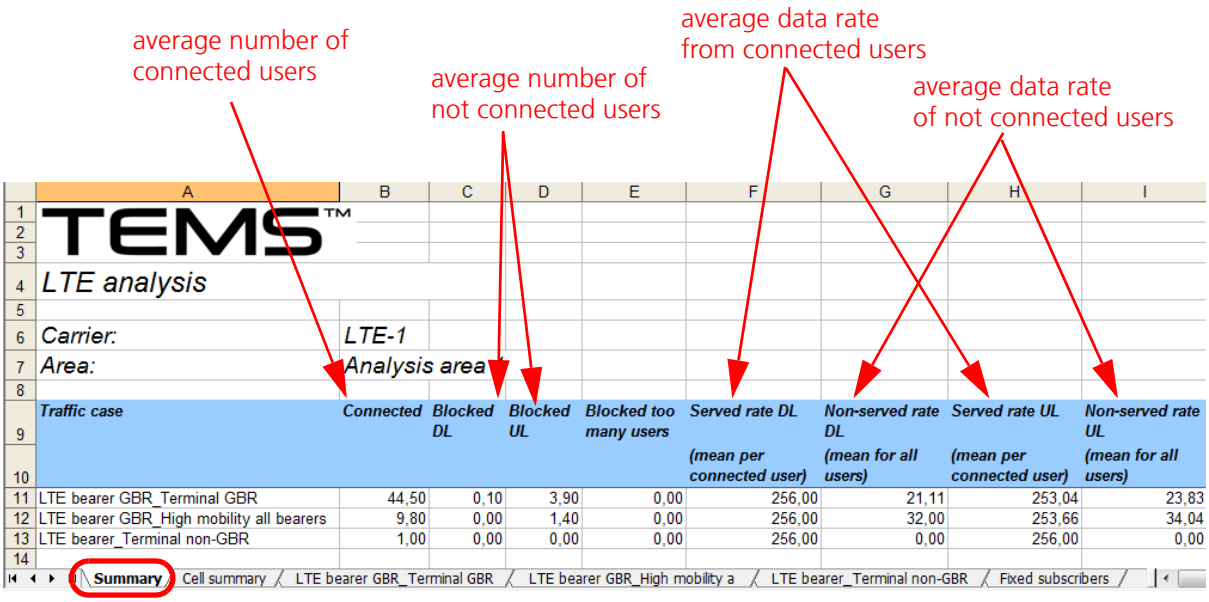
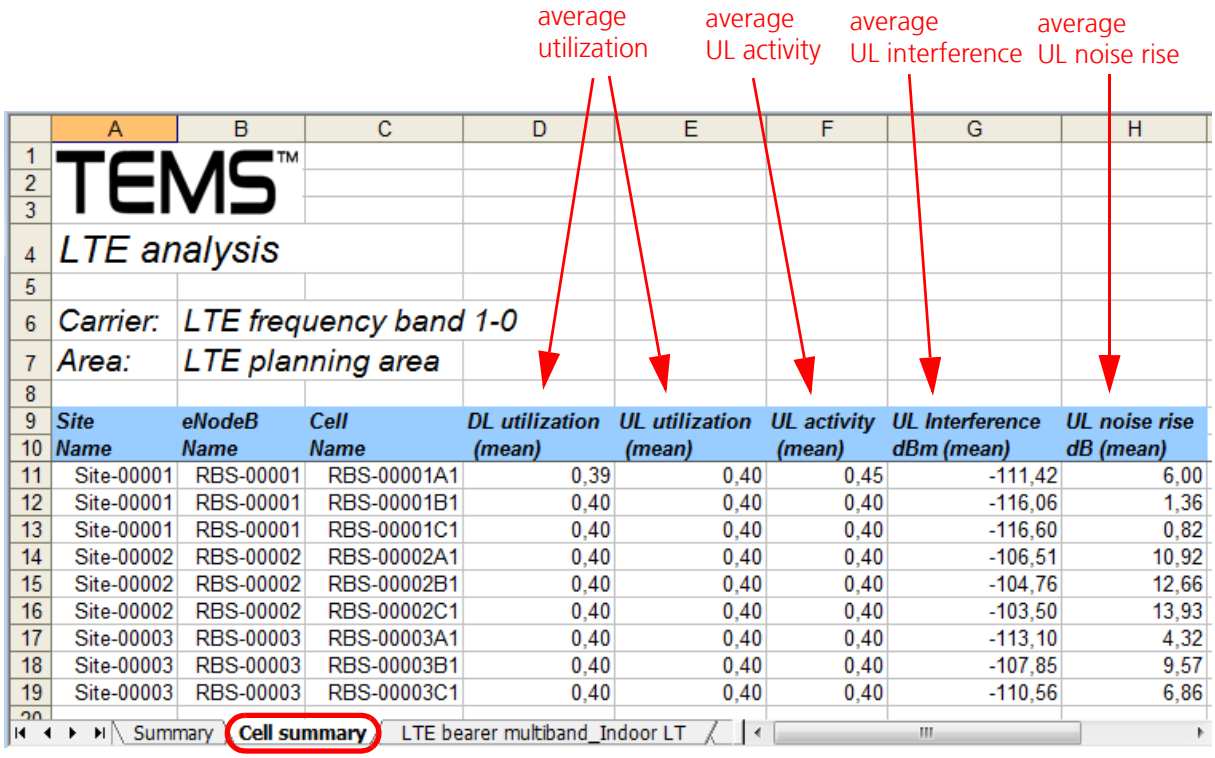


Table 14–1 Contents of summary report, with statistics per traffic case

Column	Title	Value
A	Traffic case	name of the traffic case syntax: <bearer>_<terminal type>
B	Connected	average number of served users (see plot Total Connected Users)
C	Blocked DL	average number of blocked users in downlink (see plot Users Blocked in DL)
D	Blocked UL	average number of blocked users in uplink (see plot Users Blocked in UL)
E	Blocked too many users	average number of blocked users due to too many users in the serving cell (see plot Blocked Users Due To Too Many Users)
F	Served rate DL (mean per connected user)	average served data rate in downlink in kbps (see plot (Average) DL Served Data Rate)
G	Non-served rate DL (mean for all users)	non-served data rate in downlink in kbps (see plot (Average) DL Non Served Data Rate)
H	Served rate UL (mean per connected user)	average served data rate in downlink in kbps (see plot (Average) UL Served Data Rate)
I	Non-served rate UL (mean for all users)	non-served data rate in uplink in kbps (see plot (Average) UL Non Served Data Rate)

Cell Summary, Mean Values Only

The **Cell summary** report shows average values per cell, summed over all traffic cases, as in the example below. Select **Mean values only** when generating the report.



Site Name	eNodeB Name	Cell Name	DL utilization (mean)	UL utilization (mean)	UL activity (mean)	UL Interference dBm (mean)	UL noise rise dB (mean)
Site-00001	RBS-00001	RBS-00001A1	0,39	0,40	0,45	-111,42	6,00
Site-00001	RBS-00001	RBS-00001B1	0,40	0,40	0,40	-116,06	1,36
Site-00001	RBS-00001	RBS-00001C1	0,40	0,40	0,40	-116,60	0,82
Site-00002	RBS-00002	RBS-00002A1	0,40	0,40	0,40	-106,51	10,92
Site-00002	RBS-00002	RBS-00002B1	0,40	0,40	0,40	-104,76	12,66
Site-00002	RBS-00002	RBS-00002C1	0,40	0,40	0,40	-103,50	13,93
Site-00003	RBS-00003	RBS-00003A1	0,40	0,40	0,40	-113,10	4,32
Site-00003	RBS-00003	RBS-00003B1	0,40	0,40	0,40	-107,85	9,57
Site-00003	RBS-00003	RBS-00003C1	0,40	0,40	0,40	-110,56	6,86

Table 14–2 Contents of cell summary report, mean values

Column	Title	Value
A	Site Name	site name from Site explorer
B	eNodeB Name	RBS (eNodeB) name from Site or LTE RBS explorer
C	Cell Name	cell name from Site or LTE RBS explorer
D	DL utilization (mean)	Percentage used of total DL capacity in this cell (see plot DL Utilization). A value >100% indicates that the DL capacity is too low.
E	UL utilization (mean)	Percentage used of total UL capacity in this cell (see plot UL Utilization). A value >100% indicates that the UL capacity is too low.
F	UL activity (mean)	UL activity depending on the link utilization (see plot UL Cell Activity)
G	UL interference dBm (mean)	UL interference for all RBs, received signal power from interfering terminals
H	UL noise rise dB (mean)	UL noise rise (see plot UL Noise Rise)

Cell Summary, All Values

The **Cell summary** report shows all values per cell, summed over all traffic cases, as in the example below. Select **All values** to generate the report.

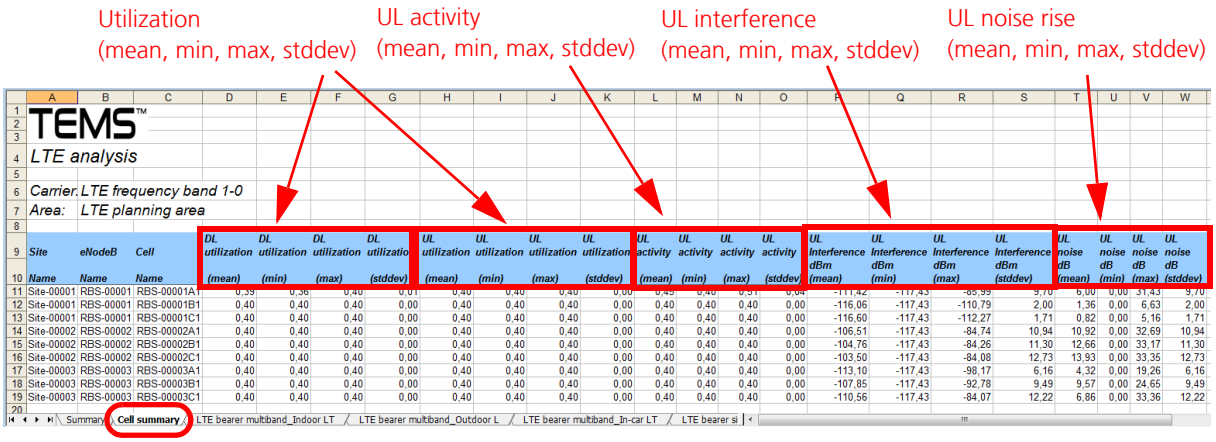


Table 14–3 Contents of cell summary report, all values

Column	Title	Value
A	Site Name	site name from Site explorer
B	eNodeB Name	RBS (eNodeB) name from Site or LTE RBS explorer
C	Cell Name	cell name from Site or LTE RBS explorer
D E F G	DL utilization (mean) DL utilization (min) DL utilization (max) DL utilization (stddev)	Percentage used of total DL capacity in this cell (see plot DL Utilization). A value >100% indicates that the DL capacity is too low.
H I J K	UL utilization (mean) UL utilization (min) UL utilization (max) UL utilization (stddev)	Percentage used of total UL capacity in this cell (see plot UL Utilization). A value >100% indicates that the UL capacity is too low.
L M N O	UL activity (mean) UL activity (min) UL activity (max) UL activity (stddev)	UL activity depending on the link utilization (see plot UL Cell Activity)
P Q R S	UL interference dBm (mean) UL interference dBm (min) UL interference dBm (max) UL interference dBm (stddev)	UL interference for all RBs, received signal power from interfering terminals
T U V W	UL noise rise dB (mean) UL noise rise dB (min) UL noise rise dB (max) UL noise rise dB (stddev)	UL noise rise (see plot UL Noise Rise)

Traffic Case, Mean Values Only

The **Traffic case** report shows the average values per traffic case and cell as in the example below. Select **Mean values only** to generate the report.

The blocking reasons are further described in the *TEMS CellPlanner LTE Technical Reference Manual*.

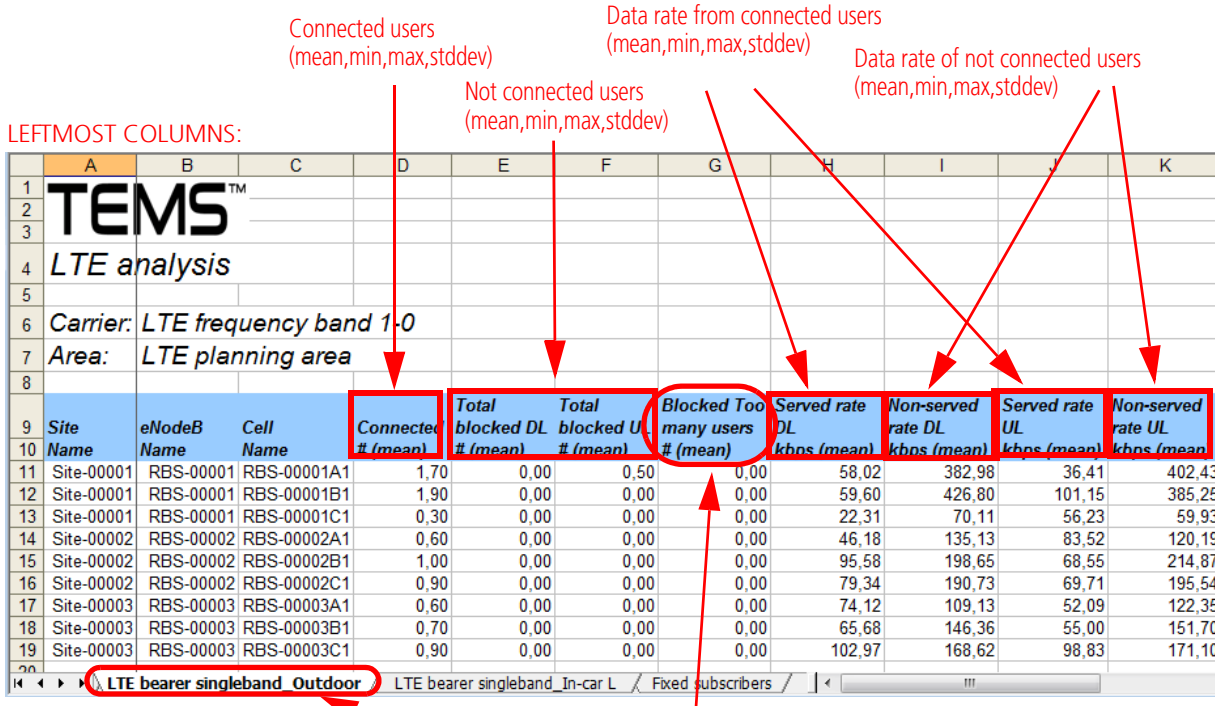


Table 14–4 Contents of report per traffic case and cell, mean values

Column	Title	Value
A	Site Name	site name from Site explorer
B	eNodeB Name	RBS name from Site or LTE RBS explorer
C	Cell Name	cell name from Site or LTE RBS explorer
D	Connected # (mean)	number of served users (see plot Users Connected)
E	Total blocked DL # (mean)	number of non-served users in downlink (see plot Users Blocked in DL)
F	Total blocked UL # (mean)	number of non-served users in uplink (see plot Users Blocked in UL)
G	Blocked Too many users # (mean)	number of non-served users in uplink and downlink, blocked to not exceed allowed number of users in cell (see plot Blocked Users Due To Too Many Users)
H	Served rate DL kbps (mean)	served data rate in downlink (see plot (Average) DL Served Data Rate)
I	Non-served rate DL kbps (mean)	non-served data rate in downlink (see plot (Average) DL Non Served Data Rate)
J	Served rate UL kbps (mean)	served data rate in uplink (see plot (Average) UL Served Data Rate)
K	Non-served rate UL kbps (mean)	non-served data rate in uplink (see plot (Average) UL Non Served Data Rate)
For details on the blocking reasons below, see the *TEMS CellPlanner LTE Technical Reference Manual*.		
L	Insufficient DL # (mean)	number of non-served users in downlink, blocked to protect the best server from overload
M	DL overloaded # (mean)	number of non-GBR users blocked in downlink as the available downlink bandwidth is less than 1 kbps
N	Rejected in DL # (mean)	number of non-GBR users, configured to be rejected on resource shortage, that are blocked in downlink to prioritize GBR users
O	DL GBR not reached # (mean)	number of GBR users blocked in downlink as required GBR cannot be granted
P	Insufficient UL # (mean)	number of non-served users in uplink, blocked to protect the best server from overload
Q	UL overloaded # (mean)	number of non-GBR users blocked in uplink as the available uplink bandwidth is less than 1 kbps
R	Rejected in UL # (mean)	number of non-GBR users, configured to be rejected on resource shortage, that are blocked in uplink to prioritize GBR users
S	UL GBR not reached # (mean)	number of GBR users blocked in uplink as required GBR cannot be granted
T	Achieved rate DL (per bin) kbps (mean)	downlink (or uplink) average served data rate, averaged over all bins in the cell
U	Achieved rate UL (per bin) kbps (mean)	

Traffic Case, All Values

The **Traffic case** report shows the average values per traffic case and cell, as in the example below. Select **All values** when generating the report.

The blocking reasons are further described in the *TEMS CellPlanner LTE Technical Reference Manual*.

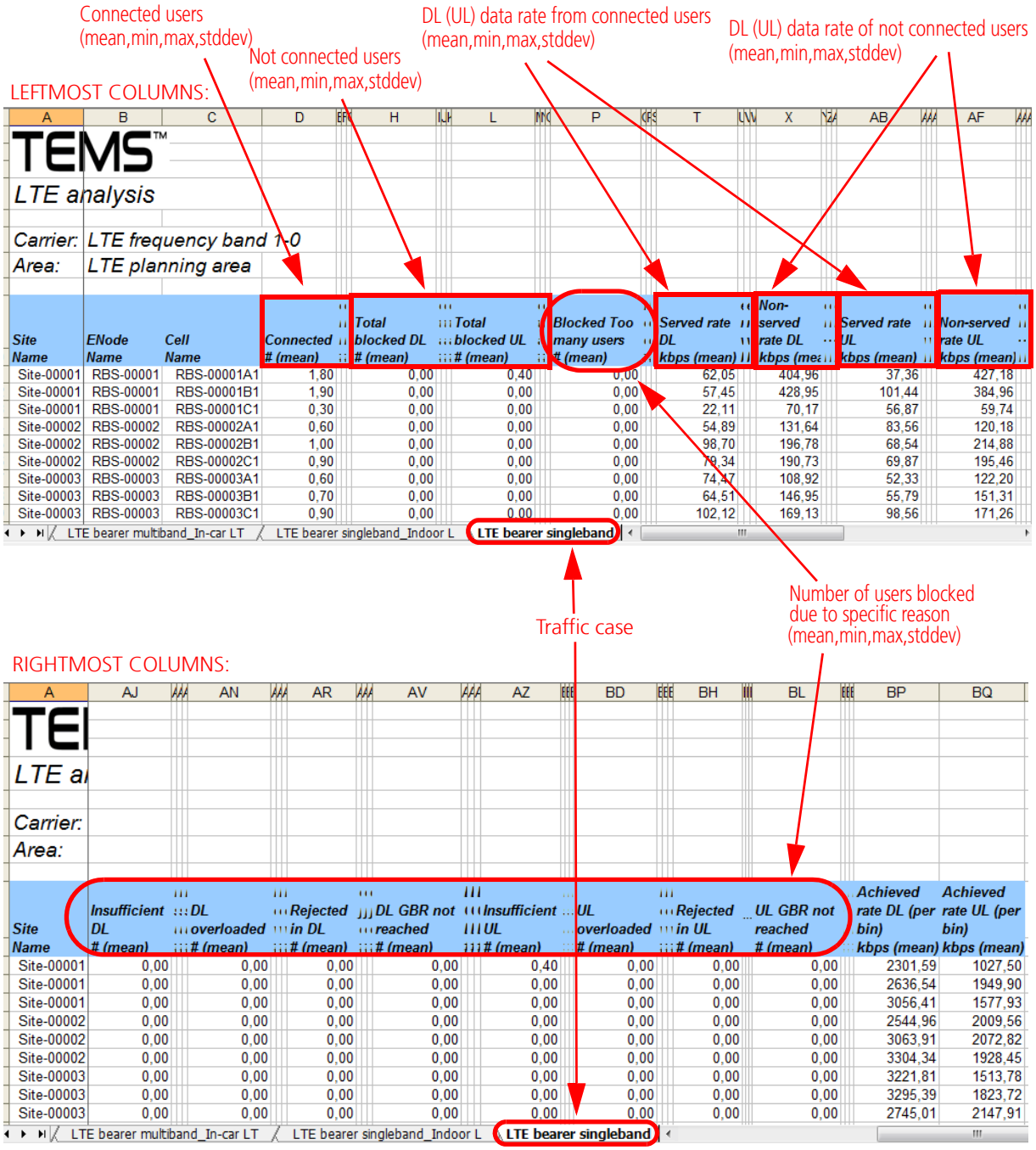


Table 14–5 Contents of report per traffic case and cell, all values

Column	Title	Value
A	Site Name	site name from Site explorer
B	ENode Name	RBS (eNodeB) name from Site or LTE RBS explorer
C	Cell Name	cell name from Site or LTE RBS explorer
D	Connected # (mean)	number of served users (see plot Total Connected Users)
E	Connected # (min)	
F	Connected # (max)	
G	Connected # (stddev)	
H	Total blocked DL # (mean)	number of non-served users in downlink (see plot Users Blocked in DL)
I	Total blocked DL # (min)	
J	Total blocked DL # (max)	
K	Total blocked DL # (stddev)	
L	Total blocked UL # (mean)	number of non-served users in uplink (see plot Users Blocked in UL)
M	Total blocked UL # (min)	
N	Total blocked UL # (max)	
O	Total blocked UL # (stddev)	
P	Blocked too many users # (mean)	number of mobile user in uplink and downlink to not exceed the number of users allowed in the cell (see plot Blocked Users Due To Too Many Users)
Q	Blocked too many users # (min)	
R	Blocked too many users # (max)	
S	Blocked too many users # (stddev)	
T	Served rate DL kbps (mean)	served data rate in downlink (see plot (Average) DL Served Data Rate)
U	Served rate DL kbps (min)	
V	Served rate DL kbps (max)	
W	Served rate DL kbps (stddev)	
X	Non-served rate DL kbps (mean)	non-served data rate in downlink (see plot (Average) DL Non Served Data Rate)
Y	Non-served rate DL kbps (min)	
Z	Non-served rate DL kbps (max)	
AA	Non-served rate DL kbps (stddev)	
AB	Served rate UL kbps (mean)	served data rate in uplink (see plot (Average) UL Served Data Rate)
AC	Served rate UL kbps (min)	
AD	Served rate UL kbps (max)	
AE	Served rate UL kbps (stddev)	
AF	Non-served rate UL kbps (mean)	non-served data rate in uplink, over all users (see plot (Average) UL Non Served Data Rate)
AG	Non-served rate UL kbps (min)	
AH	Non-served rate UL kbps (max)	
AI	Non-served rate UL kbps (stddev)	
For details on the blocking reasons below, see the *TEMS CellPlanner LTE Technical Reference Manual*.		
AJ	Insufficient DL # (mean)	number of non-served users in downlink, blocked to protect the best server from overload
AK	Insufficient DL # (min)	
AL	Insufficient DL # (max)	
AM	Insufficient DL # (stddev)	
AN	DL overloaded # (mean)	number of non-GBR users blocked in downlink as the available downlink bandwidth is less than 1 kbps
AO	DL overloaded # (min)	
AP	DL overloaded # (max)	
AQ	DL overloaded # (stddev)	

AR AS AT AU	Rejected in DL # (mean) Rejected in DL # (min) Rejected in DL # (max) Rejected in DL # (stddev)	number of non-GBR users, configured to be rejected on resource shortage, that are blocked in downlink to prioritize GBR users
AV AW AX AY	DL GBR not reached # (mean) DL GBR not reached # (min) DL GBR not reached # (max) DL GBR not reached # (stddev)	number of GBR users blocked in downlink as required GBR cannot be granted
AZ BA BB BC	Insufficient UL # (mean) Insufficient UL # (min) Insufficient UL # (max) Insufficient UL # (stddev)	number of non-served users in uplink, blocked to protect the best server from overload
BD BE BF BG	UL overloaded # (mean) UL overloaded # (min) UL overloaded # (max) UL overloaded # (stddev)	number of non-GBR users blocked in uplink as the available uplink bandwidth is less than 1 kbps
BH BI BJ BK	Rejected in UL # (mean) Rejected in UL # (min) Rejected in UL # (max) Rejected in UL # (stddev)	number of non-GBR users, configured to be rejected on resource shortage, that are blocked in uplink to prioritize GBR users
BL BM BN BO	UL GBR not reached # (mean) UL GBR not reached # (min) UL GBR not reached # (max) UL GBR not reached # (stddev)	number of GBR users blocked in uplink as required GBR cannot be granted
BP	Achieved rate DL (per bin) kbps (mean)	downlink (or uplink) average served data rate, averaged over all bins in the cell; compare with "served rate" report value which shows the rate averaged over all connected users in the cell (for downlink, see plot (Instantaneous) DL Data Rate (with Interference))
BQ	Achieved rate UL (per bin) kbps (mean)	

Fixed Subscribers

The **Fixed subscribers** report shows various performance numbers per fixed subscriber. This report can be obtained if you select to **Include** fixed subscribers in the analysis wizard Part IV: Select Traffic prior to Part V: Run Monte Carlo Analysis. Note that a report is generated only for fixed subscribers covered by cells in the analysis area, see Area Selection vs LTE Analysis, Plots and Reports on page 12-5.

The blocking reasons are further described in the *TEMS CellPlanner LTE Technical Reference Manual*.

The example below shows a report of one fixed subscriber:

LEFTMOST COLUMNS:

Fixed subscriber profile

TEMS™

LTE analysis

Carrier: LTE frequency band 1-0

Area: LTE planning area

Site	Subscriber	Longitude	Latitude	Antenna height (m)	Ground height (m)	Profile	Bearer	Requested rate DL (kbps)	Requested rate UL (kbps)	Terminal type
Site-Fixed subscriber	LTE fixed outdoor terminal	17.94237544	59.40465430	5,00	0,00	LTE fixed subscriber profile	LTE bearer singleband	256,00	256,00	Outdoor LTE terminal

LTE bearer singleband_Outdoor | LTE bearer singleband_In-car L | Fixed su

MID COLUMNS:

Best servers and traffic performance statistics

Site	Best server	Received signal strength (dBm)	C/(I+N) DL (dB)	Achieved rate DL (kbps)	Served rate DL (kbps)	C/(I+N) UL (dB)	Achieved rate UL (kbps)	Served rate UL (kbps)	Power margin UL (dB)	2nd BS	2nd BS RSS (dBm)	3rd BS	3rd BS RSS (dBm)
Site-Fixed subscriber	RBS-00001B1	-56,76	9,42	908,28	18,77	34,24	2620,09	54,08	8,05	RBS-00002A1	-57,25	RBS-00001C1	-66,28

LTE bearer singleband_Outdoor | LTE bearer singleband_In-car L | Fixed subscribers

RIGHTMOST COLUMNS:

Percentage of trials during which the terminal reached the specified state

Site	Connected (%)	Insufficient DL (%)	Insufficient UL (%)	Rejected in DL (%)	Rejected in UL (%)	DL overloaded (%)	UL overloaded (%)	DL GBR not reached (%)	UL GBR not reached (%)	Too many users (%))
Site-Fixed subscriber	100,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

LTE bearer singleband_Outdoor | LTE bearer singleband_In-car | Fixed subscribers

Table 14–6 Contents of fixed subscriber report

Column	Title	Value
A	Site	site name, from Site explorer
B	Subscriber	name of fixed subscriber, from Site explorer
C	Longitude	position of the fixed subscriber, from Site explorer
D	Latitude	
E	Antenna height (m)	antenna height over ground in meters
F	Ground height (m)	ground height in meters at fixed subscriber position
Fixed subscriber profile		
G	Profile	name of LTE fixed subscriber profile
H	Bearer	bearer of this profile
I	Requested rate DL (kbps)	required data rates for this profile
J	Requested rate UL (kbps)	
K	Terminal type	terminal type of this profile
Best servers and traffic performance:		
L	Best server	name of the best serving cell
M	Received signal strength (dBm)	signal strength of best server
N	C/(I+N) DL (dB)	achieved DL C/(I+N)
O	Achieved rate DL (kbps)	instantaneous DL data rate for the assigned bandwidth
P	Served rate DL (kbps)	served data rate in uplink, average over all time the fixed subscriber is connected
Q	C/(I+N) UL (dB)	achieved UL C/(I+N)
R	Achieved rate UL (kbps)	instantaneous UL data rate for the assigned bandwidth
S	Served rate UL (kbps)	served data rate in uplink, average over all time the fixed subscriber is connected
T	Power margin UL (dB)	power margin to reach configured target value of UL C/(I+N) or UL data rate (see Fields on Window "LTE analysis - System parameters" on page 12-20 and plots UL C/(I+N) or (Instantaneous) UL Data Rate (with Interference))
U	2nd BS	name of 2nd best server
V	2nd BS RSS (dBm)	received signal strength for 2nd best server (dBm)
W	3rd BSS	name of 3rd best server
X	3rd BS RSS (dBm)	received signal strength for 3rd best server (dBm)
Percentage of trials during which the terminal reached any of the following states:		
Y	Connected (%)	number of fixed connected users (see plot Total Connected Users including fixed and mobile users)
Z	Insufficient DL (%)	number of fixed users blocked to protect the best server from overload
AA	Insufficient UL (%)	
AB	Rejected in DL (%)	number of fixed non-GBR users configured to be rejected on resource shortage, that are blocked to prioritize GBR users
AC	Rejected in UL (%)	

AD	DL overloaded (%)	number of fixed non-GBR users blocked as the available bandwidth is less than 1 kbps
AE	UL overloaded (%)	
AF	DL GBR not reached (%)	number of fixed GBR users blocked as required GBR cannot be granted
AG	UL GBR not reached (%)	
AH	Too many users (%)	number of fixed users blocked to not exceed the number of users allowed in the cell (see plot Blocked Users Due To Too Many Users)

Site Installation Report

The site installation report is a tab separated text file for each site, with the site name as the filename.

Multiple sector and cell configuration entries are reported per site.

Refer to the *TEMS CellPlanner Common Features User's Guide* for more information on this report.

15
Advanced LTE Planning

This chapter describes how to use TEMS CellPlanner to plan cell IDs in an LTE network plan.

Topic **Page**

Cell ID Planning 15-2
- Create LTE Cell ID Plan 15-3
- Include Neighbors in Cell ID Planning 15-4
- Assign the Same CID Group to All Sectors of Each RBS 15-5
- Assign Different CID Groups to All Sectors of Each RBS 15-5
- Reserve CIDs for Future Use 15-6
- Lock Cell IDs 15-7
- View Non-Zero Costs 15-7
- Generate a Cell ID Report 15-8

Windows and Parameters of Cell ID Planning 15-10
- Algorithm Parameters Window 15-10
- CID Groups and Reserved IDs Window 15-12
- Constraints Window 15-13

Cell ID Planning

Cell IDs are used in an LTE network as a way for the UEs to distinguish the transmissions from different cells. To ensure that the cells are not mixed up, the same cell ID should not be assigned to two cells that can be heard by the same UE.

TEMS CellPlanner can generate the initial cell ID plan for you and automatically save the obtained CID assignment in the cell configuration. You can also extract the CID assignments to a report.

TEMS CellPlanner creates a cell ID plan using 168 cell ID groups and 3 cell IDs within each group. The application tries to minimize the penalty for the CID assignments as when planning WCDMA scrambling codes.

You can reuse your parameter settings as they are saved on the local PC in a folder associated with the current TEMS CellPlanner version.

Read more on cell ID planning in the *TEMS CellPlanner LTE Technical Reference Manual*.

Cell ID Planning Concepts and Terminology

CID	cell ID numbered 0..2
CID group	group numbered 0..167 containing cell IDs
CID assignment	combination of cell ID group and cell ID
target cell	the cell being assigned a CID assignment
penalty	internal name for the "cost" of a changed CID assignment
interference cost	the cost of assigning the same CID assignment for a target cell and an interfering cell
unlock cost	the cost of assigning a new CID assignment to an already planned cell which is locked to avoid losing the assignment
distance cost	the cost of assigning the same CID assignment to two cells located less than a user-defined distance from each other
neighbor cost	the cost of assigning the same CID assignment to a target cell and any of its first or second order neighbors

Create LTE Cell ID Plan

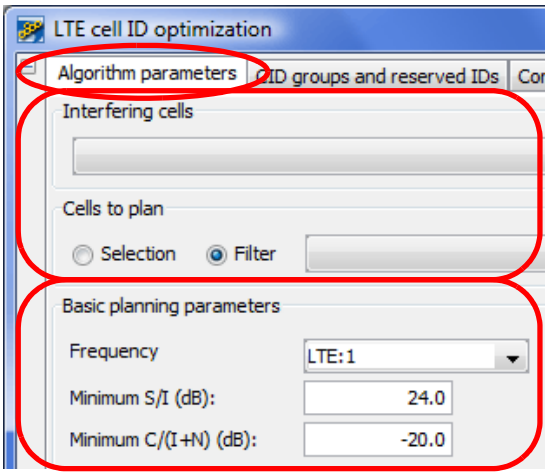
Do as follows to create an initial cell ID plan for a new LTE network, or to add cells or modify cell IDs in an LTE network under expansion.

Prerequisites

The LTE Best Server Analysis has been successfully run.

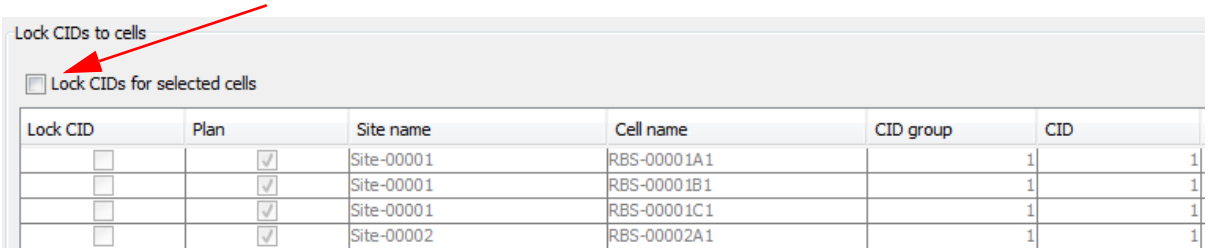
Procedure

1. Select **Analysis↗LTE↗Optimize cell ID plan...** to open the **LTE cell ID optimization** window.
2. Select tab **Algorithm parameters**. The current cell ID plan is displayed in the Algorithm Parameters Window.
3. Set the algorithm parameters as follows:
   - Optionally filter the number of cells to consider as interferers
   - Optionally filter the number of cells to plan (optimize)
   - Select the frequency
   - Set **Minimum S/I** and **Minimum C/(I+N)** for interference cost calculation.



Refer to Fields on Window: "Algorithm parameters" on page 15-11 for detailed parameter descriptions.

4. Ensure that option **Lock CIDs for selected cells** is cleared, as cell IDs shall not be locked when creating the initial plan:



5. You may also perform the following ID group planning from the CID Groups and Reserved IDs Window:
   - Assign the Same CID Group to All Sectors of Each RBS
   - Assign Different CID Groups to All Sectors of Each RBS
   - Reserve CIDs for Future Use
6. Open the Constraints Window to set the distance cost and optionally Include Neighbors in Cell ID Planning.
7. Click **Start** to start the optimization. The progress is indicated in the status field and the current cost is displayed during the optimization process. The process stops when a CID plan with zero cost is found or when you click **Stop.**
8. If the cost in the status field is non-zero you can View Non-Zero Costs.
9. Optionally Generate a Cell ID Report in Excel format.
10. Inspect the plan and click **Apply** if you are satisfied with the plan. The cell ID parameters in the LTE cell data are updated with the planned values, see Add LTE Cell on page 9-11.

Include Neighbors in Cell ID Planning

To decrease the risk that the same cell ID is used by 1st or 2nd order neighbors it is recommended that you use an up-to-date neighbor list when planning the cell IDs.

Prerequisites

- The LTE Best Server Analysis must have been run successfully.
- You have imported or created an LTE intra-frequency neighbor list including the cells to plan. See Import and Export of Other Data on page 10-3 and Generate LTE Neighbor Lists on page 12-30.

Procedure

Do as follows to include the neighbor list in the cell ID planning:

1. Select the cells to plan and other basic settings as described in Create LTE Cell ID Plan on page 15-3.
2. Set the **Neighbor costs**, see Constraints Window on page 15-13. You can set separate costs for 1st and 2nd order neighbors.
3. Proceed with the cell ID optimization as in Step 7 in Create LTE Cell ID Plan on page 15-3. The cell ID plan is updated with neighbors taken into account.

Assign the Same CID Group to All Sectors of Each RBS

With CID group planning you can override the normal cell ID planning by steering the CID assignments within each planned RBS. This procedure describes how to ensure that all sectors within an RBS get the same CID assignment. See the other case in Assign Different CID Groups to All Sectors of Each RBS.

Note: *You must manually ensure to reserve more than one CID group if an RBS has more than three sectors, as each CID group has three CIDs only.*

Prerequisites

The LTE Best Server Analysis must have been run successfully

Procedure

Do as follows to assign the same CID group number to all sectors of each RBS:

1. Select the cells to plan and other basic settings as described in Create LTE Cell ID Plan on page 15-3.
2. Select tab **CID groups and reserved ID** to open the CID Groups and Reserved IDs Window on page 15-12.
3. Select option **Enable CID group planning**.
4. Select **Use same CID group at site**.
5. Proceed with the cell ID optimization as in Step 7 in Create LTE Cell ID Plan on page 15-3. All sectors of each RBS will belong to the same CID group.

Assign Different CID Groups to All Sectors of Each RBS

With CID group planning you can override the normal cell ID planning by steering the CID assignments within each planned RBS. This procedure describes how to ensure that all sectors within an RBS are assigned different CID groups. See the other case in Assign the Same CID Group to All Sectors of Each RBS.

Prerequisites

The LTE Best Server Analysis must have been run successfully.

Procedure

Do as follows to assign different CID group numbers to all sectors of each RBS:

1. Select the cells to plan and other basic settings as described in Create LTE Cell ID Plan on page 15-3.
2. Select tab **CID groups and reserved ID** to open the CID Groups and Reserved IDs Window on page 15-12.
3. Select option **Enable CID group planning**.
4. Select **Use different CID group at site.**
5. Proceed with the cell ID optimization as in Step 7 in Create LTE Cell ID Plan on page 15-3. All sectors of a same RBS will belong to different cell ID groups.

Reserve CIDs for Future Use

With CID reservation you can reserve a part of the CIDs for later use. The reserved CIDs will not be assigned to any cell in the cell ID optimization.

You can reserve either a specific number of CID groups, a percentage of all CIDs, or specific CID groups. You can even reserve specific combinations of CID group and CID.

Prerequisites

The LTE Best Server Analysis must have been run successfully.

Procedure

Do as follows to reserve CIDs:

1. Select the cells to plan and other basic settings as described in Create LTE Cell ID Plan on page 15-3.
2. Select tab **CID groups and reserved ID** to open the CID Groups and Reserved IDs Window on page 15-12.
3. Select option **Enable CID reservation** to enable the reservation alternatives.
4. To reserve a certain number of CID groups, select option **Reserve number of CID groups** and enter the number of CID groups to reserve.
5. To reserve a a certain percentage of CIDs, select option **Reserve percentage of CIDs** and enter how many per cents of the CIDs that shall be reserved.
6. To explicitly reserve specific CID groups or CIDs do as follows:
   a. Select option **Reserve specific CID groups or IDs within groups**.
   b. Select a CID group by clicking in its **CID group** column.
   c. To reserve a CID group, click in the **Reserve** column of the group.

d. All CIDs of a selected group are by default selected. To change the CID reservation, click in the **Reserve** column of the CID entry.

e. To reserve more CID groups or CIDs, repeat from Step b.

6. Proceed with the cell ID optimization as in Step 7 in Create LTE Cell ID Plan on page 15-3. The selected CIDs will not be assigned to any cell.

Lock Cell IDs

When expanding an existing network or when planning border areas you might want to lock existing CIDs to avoid a domino effect of reassignments during the cell ID optimization. If you do not lock cell IDs, the cell ID optimization might change an already assigned cell ID and force a change of cell IDs in the entire network plan.

You can completely disallow unlock of locked cells, or allow unlock at the cost of a configured unlock cost to decrease the risk of reassigning cell IDs.

Prerequisites

- The loaded project includes an existing cell ID plan, see Create LTE Cell ID Plan on page 15-3. The plan does not need to be applied.
- The LTE Best Server Analysis is successfully run.

Procedure

Do as follows to lock CID assignments to cells:

1. Select the cells to plan and other parameter settings as described in Create LTE Cell ID Plan on page 15-3.
2. Select the **Lock CIDs for selected cells** option.
3. For all cells where you want to keep already assigned CID assignments, select the **Lock CID** option. You can also use the **Lock/unlock all** button.
4. Set the **Unlock costs** in the Constraints Window. You can either allow unlock at a certain cost, or not allow unlock at all.
5. Proceed with the cell ID optimization as in Step 7 in Create LTE Cell ID Plan on page 15-3. The cell ID plan is updated.

View Non-Zero Costs

Once a cell ID plan is created you can view a list of non-zero costs, sorted from highest to lowest cost contribution. The list displays the following:

- Remaining cost (empty if all costs were eliminated during cell ID planning)
- Cells with conflicting assignment (empty if no conflict exists).

Prerequisites

The loaded project includes an existing cell ID plan, see Create LTE Cell ID Plan on page 15-3. The plan does not need to be applied.

Procedure

1. Select **Analysis↗LTE↗Optimize cell ID plan...** to open the **LTE cell ID optimization** window.
2. Click the **View cost** button to see a list of all CID assignments with a certain cost. The button is not selectable if there are no remaining costs or conflicts.

Generate a Cell ID Report

You can extract the cell ID plan as an Excel report with the following info per cell:

Lock CID	true if current CID is locked to the cell
Plan	true if the cell is included in the optimization
Site name	
Cell name	
CID group	current cell ID group
CID	current cell ID
New CID group	optimized CID group (same as current if applied)
New CID	optimized proposed CID (same as current if applied)

Example

8	Lock CID	Plan	Site name	Cell name	CID group	CID	New CID group	New CID
9	false	true	Site-00001	RBS-00001A1	21	1	21	1
10	false	true	Site-00001	RBS-00001B1	89	2	89	2
11	false	true	Site-00001	RBS-00001C1	38	2	38	2
12	false	true	Site-00002	RBS-00002A1	146	0	146	0
13	false	true	Site-00002	RBS-00002B1	88	2	88	2
14	false	true	Site-00002	RBS-00002C1	75	1	75	1
15	true	true	Site-00003	RBS-00003A1	1	1		
16	false	true	Site-00003	RBS-00003B1	145	1	145	1
17	false	true	Site-00003	RBS-00003C1	56	1	56	1
18	false	true	Site-00004	RBS-00004A1	116	1	116	1
19	false	true	Site-00004	RBS-00004B1	84	0	84	0

Prerequisites

The loaded project includes an existing cell ID plan, see Create LTE Cell ID Plan on page 15-3. The plan does not need to be applied.

Procedure

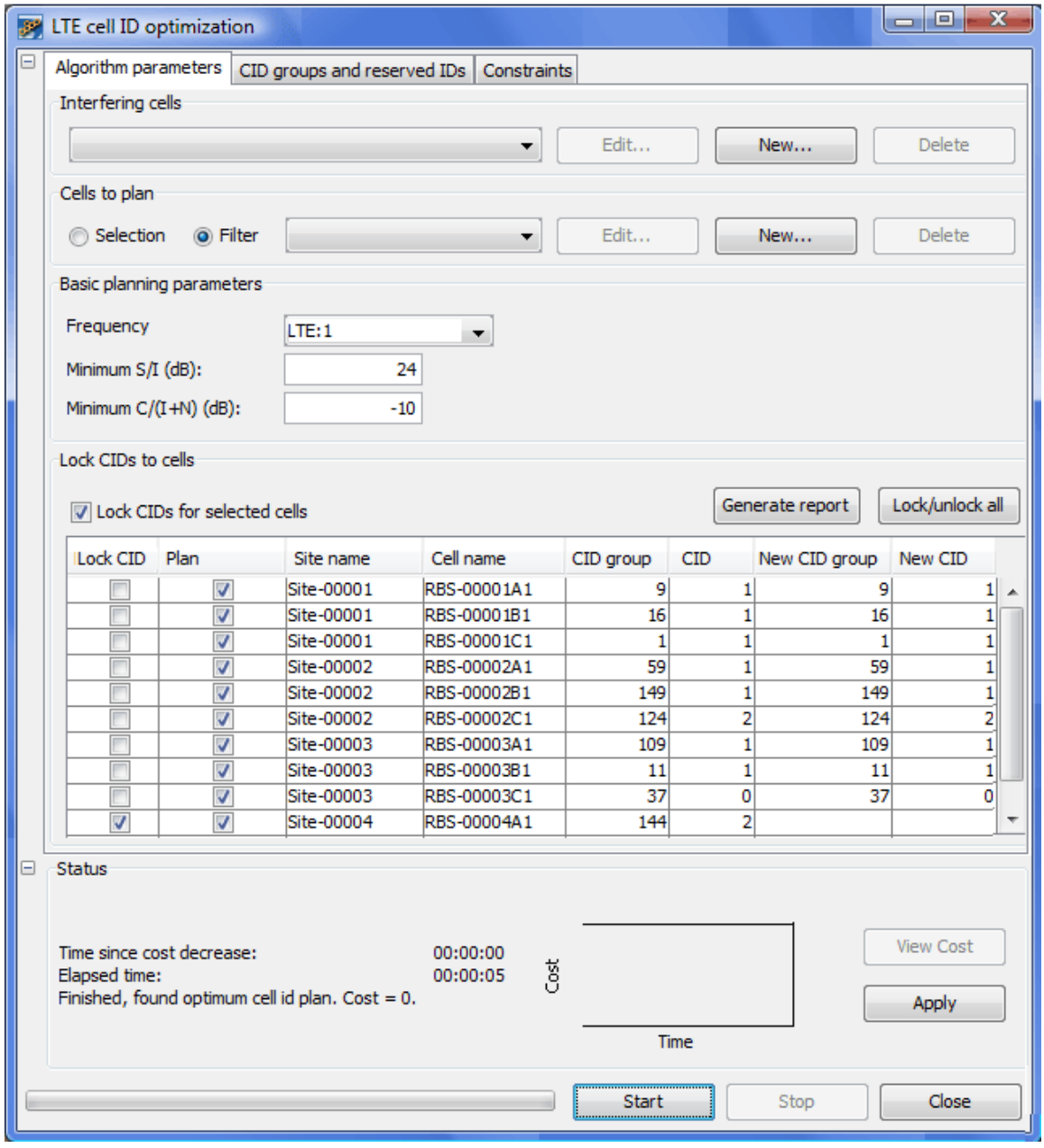
Do as follows to extract the cell ID plan to a report:

1. Select **Analysis↗LTE↗Optimize cell ID plan...** to open the **LTE cell ID optimization** window.
2. Select the **Algorithm parameters**. The Algorithm Parameters Window opens.
3. Click the **Generate report** button. An Excel file with the cell ID plan appears.
4. Save the Excel file.

Windows and Parameters of Cell ID Planning

Algorithm Parameters Window

Use this window to set filters and thresholds for interfering cells and cells to plan, and to lock already assigned CIDs. See Fields on Window: "Algorithm parameters" on page 15-11.



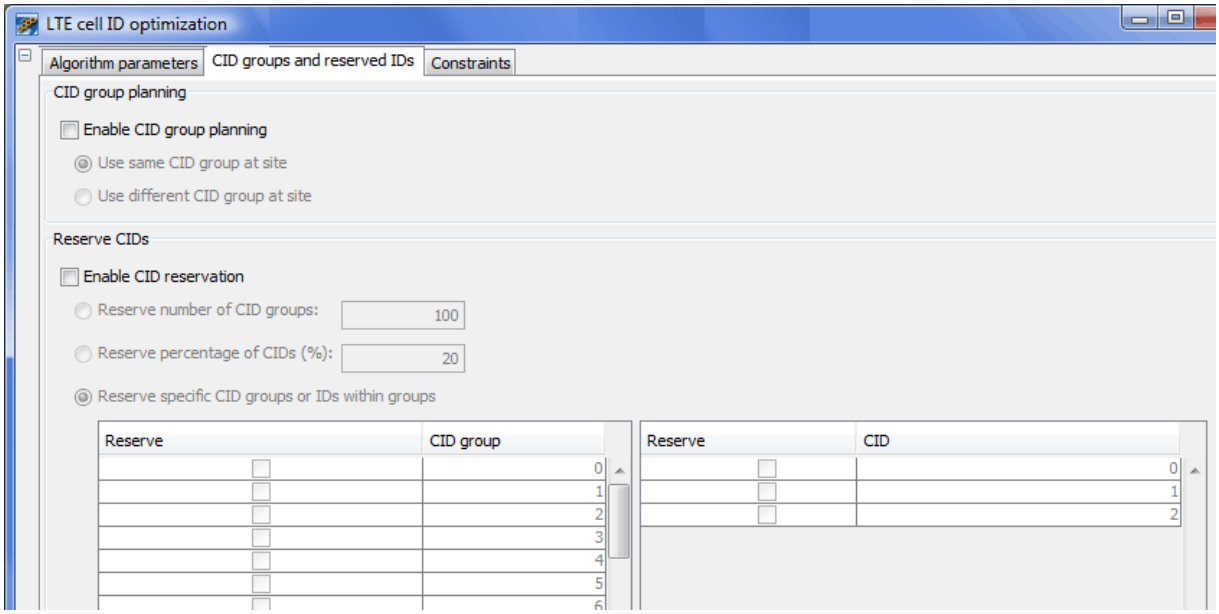
Fields on Window: "Algorithm parameters"

Field	Description
Interfering cells	Optional filter to limit the number of interferers. Interfering cells contribute to the interference cost of the target cell.
Cells to plan	Optional filter to limit the number of cells to include in the LTE cell ID planning
Basic planning parameters	
Frequency	Results from LTE best server analysis of this carrier are taken as input to the LTE cell ID planning. Syntax: `<frequency band>:<EARFCN number>`
Minimum S/I (dB)	Only cell pairs with an S/I smaller than this threshold in a bin will contribute to the interference cost in that bin. Range: 0 - 50 dB. Initial value = 24 dB.
Minimum C/(I+N) (dB)	Only cells with a C/(I+N) equal to or larger than this threshold in a bin will be considered as target cells in the interference cost calculation for that bin. Range: -50 up to 0 dB. Initial value = -20 dB.
Lock CIDs to cells	
Lock CIDs for selected cells	Enables locking or unlocking already assigned CIDs in the CID assignments table by enabling the **Lock ID** options and the **Lock/unlock all** button. If the option is unselected no CIDs are locked regardless of the selections in the CID assignments table. Initially unselected.
Lock/unlock all	When **Lock CIDs for selected cells** is enabled, this button can be used to lock or unlock all cells to plan.
CID assignments table - one CID assignment (and row) per cell:	
Lock CID	Select this option to decrease the risk that the cell is given a new CID assignment. All cells with locked CID get an unlock cost. Initially unselected.
Plan	Read-only. Only the selected cells will be included in the cell ID optimization. Initially all LTE cells are displayed and selected as planned. Cells can be excluded from planning by the filter **Cells to plan**.
Site name	Read-only. Name of the site with LTE cell(s).
Cell name	Read-only. Name of LTE cell.
CID group	Read-only. CID assignment in the cell data. Ranges: 0 - 167 and 0 - 2.
CID	
New CID group	Read-only. New CID assignment after running the cell ID optimization. Ranges: 0 - 167 and 0 - 2.
New CID	
Generate report	Generates an Excel sheet of the cell ID plan
View cost	Displays a list of CID assignments with non-zero cost
Apply	Feeds back the cell ID values to the cell data

CID Groups and Reserved IDs Window

You can override the normal cell ID planning by steering the CID assignments using one or both of the below methods:

- **CID group planning**, where you select either to assign the same CID group or definitely not the same CID groups for all sectors of each planned site, or
- **CID reservation**, where you reserve a part of the CIDs for later use.

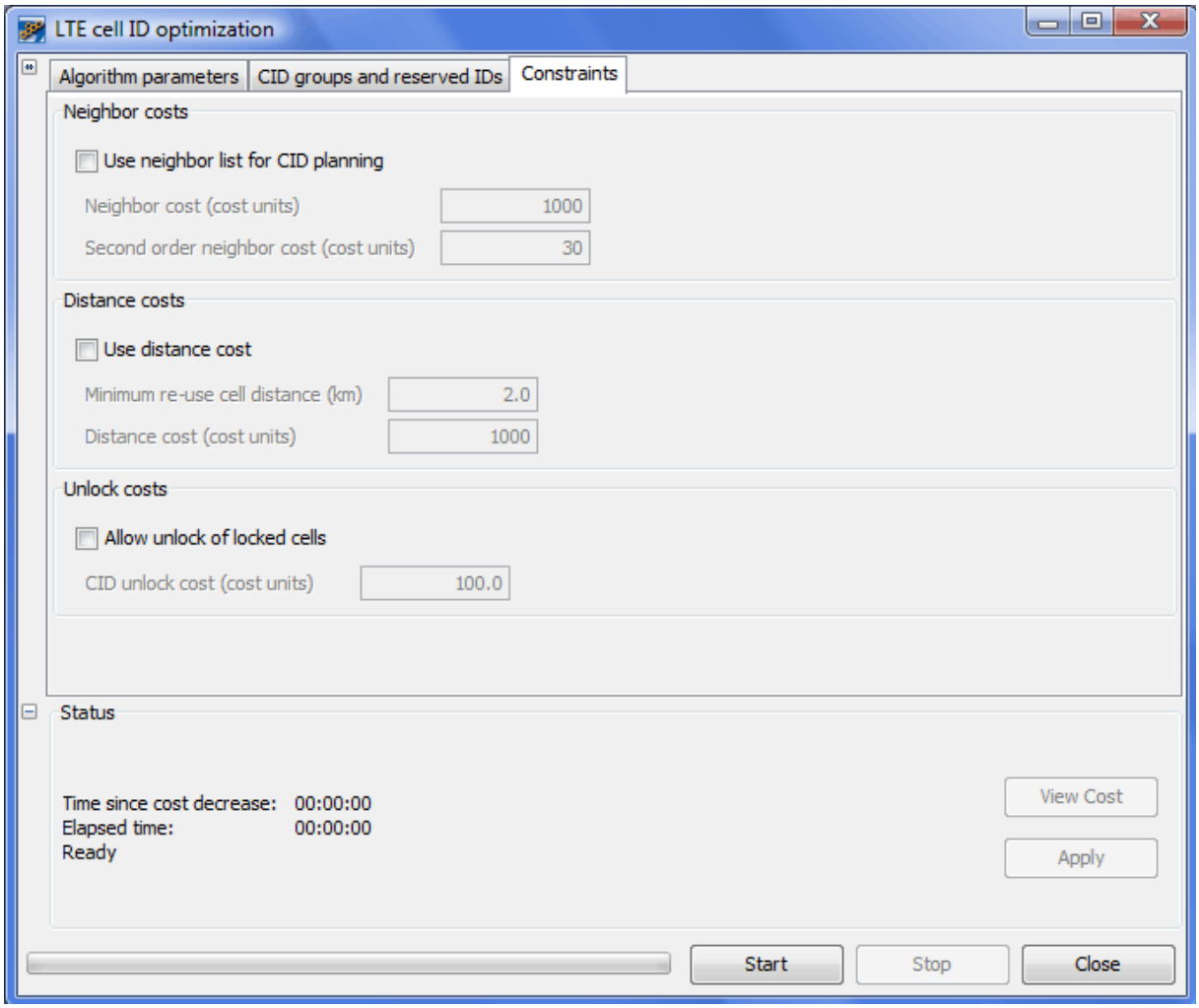


Fields on Window: "CID groups and reserved IDs"

Field	Description	
CID group planning		
Enable CID group planning	Initially unselected. When selected, cell ID groups are taken into account in the planning of a frequency layer according to one of these options: • Use same CID group at site • Use different CID group at site	
Reserve CIDs		
Enable CID reservation	Initially unselected. When selected, the selected CIDs will be excluded from the cell ID planning. Cell IDs can be reserved from all Cell ID groups in one of the following ways:	
	• Reserve number of CID groups	Range: 0 - 140. Initial value = 0.
	• Reserve percentage of CIDs (%)	Range: 0 - 85%. Initial value = 0.
	• Reserve specific CID groups or IDs within groups	Selecting option "Reserve" of a CID group selects all its CIDs. Clearing option "Reserve" unselects the CIDs or CID groups. CID group range: 0 - 167. CID range: 0 - 2.
View cost	Displays a list of CID assignments with non-zero cost	
Apply	Applies the cell ID plan and feeds back the cell ID values to the cell data	

Constraints Window

Use the **Constraints** window to set costs for the cell ID planning.



Fields on Window "Constraints"

The different costs are further described in the *TEMS CellPlanner LTE Technical Reference Manual*.

Field	Description
Neighbor costs	
Use neighbor list for CID planning	When this option is selected, an imported or created neighbor list is taken into account when generating cell IDs.
Neighbor cost (cost units)	Relevant if option **Use neighbor lists** is selected. Penalty for assigning the same CID to a neighbor cell. Range: 0 - 1 000 000. Initial value = 1000 cost units.
Second order neighbor cost (cost units)	Relevant if option **Use neighbor lists** is selected.Penalty for assigning the same CID to a neighbor's neighbor. Range: 0 - 100 000. Initial value = 30 cost units.
Distance costs	
Use distance cost	When this option is selected, distance costs are taken into account when generating cell IDs.
Minimum re-use cell distance (km)	Relevant if option **Use distance cost** is selected. A distance cost will be applied for using the same CID in two cells within this distance. Range: 0 - 100. Initial value = 2 km.
Distance cost (cost units)	Relevant if option **Use distance cost** is selected. Penalty for assigning the same CID to cells located too close to allow CID re-use. Range: 0 - 100 000. Initial value = 1000 cost units. Initial value:
Unlock costs	
Allow unlock of locked cells	When this option is selected, unlock costs are taken into account when generating cell IDs.
CID unlock cost (cost units)	Relevant if option **Allow unlock of locked cells** is selected. Penalty for assigning a new CID to a cell with a locked CID. Range: 0 - 100 000. Initial value = 100 cost units.

16
Filters

Filters limit the operations on an LTE network plan, logically or geographically.

Read chapter *Filters* in the *TEMS CellPlanner Common Features User's Guide* to learn more on this topic.

17
Maps and GeoData

A network plan is based on radio network data and map related information, GeoData.

As a radio network designer you need a basic knowledge about GeoData and how to use it in TEMS CellPlanner.

As a map administrator you need a deeper knowledge about GeoData, how to convert maps and perform other advanced GeoData related operations in TEMS CellPlanner.

Read more about GeoData in the *TEMS CellPlanner GeoData User's Guide*.

18
Puncturing

You can improve the accuracy of the pathloss predictions by using measured values of received power in selected parts of the LTE network plan.

This feature describes how to read measurement data from TEMS Investigation, TEMS Automatic and TEMS Pocket, and how to save the imported measurements as pathloss data files for later use in pathloss calculations.

Read more in *Using Puncturing* in the *TEMS CellPlanner Common Features User's Guide*

The recommended feature for integration of measurement data for pathloss calculations is Automatic Measurement Integration (AMI), described in the *TEMS CellPlanner Common Features User's Guide*.

19
Live Traffic Spreading

You can import live traffic from a text file to distribute it in your network plan.

Briefly summarized, you select a traffic case for which an LTE Best Server plot has been generated. Optionally you also select a set of land use code weights, defined in an existing traffic density map. TEMS CellPlanner then distributes the traffic for each cell over its best server coverage area to generate a traffic density map, with or without land use weighting.

Refer to the *TEMS CellPlanner WCDMA User's Guide* for a detailed description on how to import and distribute live traffic.

20
Script Console

The script utility enables a TEMS CellPlanner user to perform complex customized operations from the **Utilities** menu.

The script support is based on Jython, a variant of Python supporting Java. Before using the script console, you must learn the basics of Python.

Scripts can access and modify a network configuration loaded into the client. Most dialogs in the tool can also be controlled by scripts. Scripts can be executed automatically at startup of a client.

Examples of script usage:

- Conditional modification of attributes
- Advanced search
- Specialized reports
- Specialized imports
- Sophisticated object renaming operations

Read more in **Help↗Manuals↗Script Support**.

21
LTE Glossary

The terms used when planning an LTE network are included in the *Glossary* of the *TEMS CellPlanner Common Features User's Guide*.

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